THE AMERICAN GAS LIGHT JOURNAL

REDMAN & KENNY, N.Y.

PUBLISHING OFFICE No. 42 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME LI.—No. 4. Whole No. 737. | NEW YORK, MONDAY, JULY 22, 1889. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
JOS. R. THOMAS, C.E., Editor. T. J. CUNNINGHAM, Asst. Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y. AS SECOND CLASS MATTER.

Published on each Monday of the year, at No. 42 Pine Street, N. Y.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $4.00 (17 shillings—20 francs). All payments to be made in advance. Single copies, 10 cents.

Remittances should be made either by post-office order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

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BRIEFLY TOLD.

A CONFESSION AND WHY IT IS MADE.—In attempting to give the current news of the month that is interesting to gas men, and which contains nothing connected with the technical development of the business of gas making, a paper like the JOURNAL is largely at the mercy of its correspondents. Hitherto we have managed to adhere closely to the actual truth in the details presented, and it would beyond a doubt surprise our readers could they but see from week to week the amount of matter that is rejected (by the way, it must all be paid for) solely because it does not bear the stamp of thorough reliability. Some of these rejected matters are of real interest, and would be entertaining if presented within a reasonably short period of their happening; but that matter is newsy, if not sensational, is never a reason for its publication unless the management of the JOURNAL is at least reasonably sure that the findings are authentic. The country, however, is a big one, and telegraphic dispatches often remain unanswered, until the items concerning which the same were sent have, in newspaper parlance, become stale. This is not put forward as a complaint; for we are fully alive to the fact that it is better that the news columns should appear dull rather than that they should become a medium for the retailing of fancy instead of the reflex of fact. We are led to this train of thought from the fact that in our issue of the 8th inst. appeared an item detailing the application of certain parties to the local authorities of Methuen for the right to operate a gas company there. Our information came in the regular manner, and by way of Boston, from a correspondent who has furnished us with a great deal of valuable information concerning gas matters in the Eastern States during the past two years. From our correspondent's inclosure (he since has written us that the information was given him by a resident of Methuen) it would seem that Methuen, which is but 2 miles or so distant from the busy borough of Lawrence, Mass.—in fact, we think a line of horse railway connects both places—was anxious to have gas, and that, failing the willingness of the Lawrence Company to supply the demand, home capital proposed to correct the situation. The only inference that we could take from this—our correspondent says that his Methuen informant did not tell him that the pipes of the Lawrence Company were laid in Methuen, and that he (our correspondent) was ignorant of such fact—was that the Lawrence Company acted injudiciously, to say the least, in not taking advantage of such a fertile field. What we did say about it, to be precise, was this: "Methuen has perhaps 6,000 inhabitants, and it seems more than strange that the Lawrence Company did not take possession of this fertile field at a time when there was no fear of a contest over it." We submit, from our then knowledge of the situation, that this comment was neither an improper nor a severe one; but in the light of our current information, that comment was both improper and severe, in that it reflected on the capacity of those in charge of the affairs of the Lawrence Gas Company. It is not pleasant to have to admit that one is in error, but as justice is not remarkable for the softness of its touch, and as the JOURNAL always wishes to be just and nothing else, we have only here to state the facts as they are, which will show that the Lawrence Company is not at fault. Also, that in all probability the Methuen separate scheme is fostered by specious operators of the opposition gas charter class. The Lawrence Company has been supplying

gas in Methuen, and was ready at any time to increase the service. This increase was not demanded by the residents, and the present cry about poor or imperfect gas facilities was raised solely by speculators whose profit was not all to be made by making gas for distribution in the district.

RESIGNATION OF MR. WM. CARTWRIGHT, OSWEGO, N. Y.—At the annual meeting of the Oswego (N. Y.) Gas Light Company the following officers were elected: President, Jno. K. Post; Secretary and Treasurer, W. L. Welsh. A resolution was also adopted under which, from and after September 1st, the gas rate is to be put at $2 per 1,000 cu. ft., with a discount of 5 per cent. for prompt payment. What interests us more particularly in this announcement is the fact that the list of officers returned shows a change which, although we were not altogether unprepared for it, nevertheless occasions us deep regret. This is the refusal of Mr. Wm Cartwright to continue in harness as Superintendent of the Company, which post had been honorably and capably filled by him for nearly if not quite 30 years. Hereafter the positions of Secretary and Treasurer are to carry with them the duties of Superintendent also, and Mr. Welsh (who is a son-in-law of Mr. Cartwright) has been appointed to the post. There is no doubt that he will be found to be the right man for the responsibilities thus assumed, but we yet regret the fact that Mr. Cartwright persisted in resigning. There can be no doubt that he has fairly earned the respite from active work that long years of application and carefulness should bring, but that respite still means a break in the ranks. On the occasion of his resignation the Directors passed the following resolutions, which will be unanimously indorsed by every member of the fraternity who reads them:

Whereas, Mr. Wm. Cartwright, the Manager of this Company for the past 30 years, has tendered his resignation of the Superintendency, and

Whereas, we desire to express our appreciation of his faithful services and his honorable and upright course in the discharge of his duties, therefore

Resolved, That we herewith express our recognition of his long and efficient labors in the interests of the Company, not alone in its management, but in the construction of a large part of its works, and we therefore accept his resignation with great reluctance,

Resolved, That these resolutions be spread upon our minutes and a copy be published in the daily papers of this city.

Surely, this is a kindly and merited recognition of the valuable services of a worthy servant.

THROUGH the courtesy of Messrs. Dickerson & Dickerson of this city, of counsel for the United Gas Improvement Company, in the suit brought by the latter against the New Haven Gas Light Company for damages because of its alleged infringement of patent rights (under the Lowe process) through the use and employment of the Hanlon-Leadley process at New Haven, we have been allowed to make a hasty examination of the decision rendered by Judge Wallace, sitting in the United States Circuit Court for the District of Connecticut. The judgment sustains the complainant's side of the case in almost every particular. The New Haven Company will not bear the brunt of the damages, since it was guaranteed immunity from the consequences of a suit by the contractors who installed the plant. The concluding portions of Judge Wallace's decision are: "Invention was not necessarily absent in making the substitution of the firing chamber of patent for the firing chamber of Harkness, because Siemens had previously used his device to superheat a different gas. It would have been absent if the Siemens device had been obviously adapted to supply the place of the externally heated firing chamber in the Harkness apparatus. But the inquiry is whether the adaptability of the Siemens superheater to fix the gas of the Harkness patent was self-evident to the intelligence of those skilled in the art. If it had been why was not the substitution made? It introduced very desirable advantages into the process of making illuminating water gas. The experts on both sides concede that the firing chamber of the patent can be heated more economically and more quickly than the firing chambers which were previously used, as in the Harkness apparatus, or in similar apparatus. If the making of this change had been an obvious thing, falling within the range of ordinary mechanical adaptation, it is probable that those skilled in the art would have sought to avail themselves of its advantages. Yet, as appears by the prior patents in the record, the more expensive method of fixing the gas in retorts heated by external fires was everywhere followed. The various manufacturers of this country who were making gas according to the Tessie du Motay process, and using the externally fired retort, did not discover what it is now asserted was an obvious thing. The fact that the older organizations which it is now claimed were susceptible of being modified by mere mechanical skill into the apparatus of the patent remained without any such modification until the patentee [Prof. Lowe] made it, and his improvement when made was so useful and valuable as to commend itself at once to those skilled in the art to which it relates, is sufficient to resolve any doubt whether the improvement embodies invention in favor of the patent." The decision is certainly a sweeping one.

A SAMPLE OF HOW SELECTMEN CHOOSE THEIR FAVORITES.—We have already printed the edifying call issued some time ago by the Dedham (Mass.) Electric Committee for bids for electric lighting, and also gave the bid of the Dedham and Hyde Park Gas and Electric Light Company in response thereto. In continuation of the proceedings connected therewith our readers will perhaps be amused to learn that the committee, finding the Company's bid so favorable to the town that it could not be ignored, threw out all bids and issued another call, on the ground that they had discovered that they did not want more than 20 arc lights, and that the remainder (not less than 250 lights) must be incandescents of the 25-candle power variety—the lamps to be located by the Selectmen substantially "on a plan herewith submitted." As no plan accompanied the call sent to the Gas Company, the representative of the latter wrote the committee asking for a copy of the plan, or for leave to inspect the same. To this request a written reply was forwarded to the effect that the plan referred to was one which had been made by one of the competing parties, and it would not be fair to let the Gas Company see it! Whereupon the Gas Company, through its Directors, informed the committee that, having been invited to make proposals for lighting streets according to a certain plan, and an inspection of that plan having been denied them, they declined to make any further bids. The contract was then awarded to the Dedham Electric Company (as was beyond doubt the original intention of the authorities), which permits the latter to supply 20 arc lights and 290 incandescent lights, each of 25-candle power, over a circuit of about 25 miles, for a term of 10 years, for $5,000 a year. The Gas Company will appeal to the Gas Commissioners.

ELECTRIC LIGHTING AWARDS, NEW YORK CITY.—The following awards for the arc lighting of New York city for the current year have been made by the Gas Commission:

Name of Company.	No. Lamps.	Price per Night.
Brush	297	35 cents.
"	70	45 "
East River	169	35 "
United States	306	35 "
"	169	29 "
"	162	25 "
Mount Morris	11	25 "
"	18	24 "
"	28	23 "
Harlem	49	35 "
Not awarded	67	

AFFAIRS AT ALTON, ILLS.—The condition of the gas and electric light supply of Alton, Ills., which is under control of the local gas men, while giving ample satisfaction to the Company's proprietors, is also satisfactory to the consumers. Since last May 25 gas cooking stoves have been added to those already in use, and Mr. Tracy is ready to put in as many more. The officers of the Company are: Directors, T. J. Underwood, A. E. Campbell, Levi Davis, and William Tracy; President and Treasurer, A. E. Campbell; Secretary and Superintendent, William Tracy. The latter gentleman, it will be remembered, a few weeks ago resigned the Superintendency at Peru, Ind., to take charge at Alton. He is sure to make a success of it.

ANNUAL MEETING, RUTLAND, VT.—The annual election of the Peoples Gas Light Company, of Rutland, Vt., was held last Monday, Mr. J. N. Baxter acting as Chairman of the gathering. It is our pleasant task to say that the annual reports proved the financial standing of the Company to be better than ever, and that the quantity of gas sent out in the twelvemonth was the largest known in its history. Ten years ago the Company had a debt of $7,000, and not only has this been paid off but a regular dividend has also been divided amongst the shareholders. At the present meeting a semi-annual dividend of 3 per cent. was declared, payable August 15. The officers elected were: Directors, J. W. Cranston, John N. Baxter, John A. Shelden, S. M. Wilson and E D. Keyes. President, Wm. B. Mussey; Secretary and Treasurer, G. R. Bottum; Superintendent, N. C. Dye. During the year important repairs were made on the works.

[A Paper read before the British Gas Institute.]

Experience in the Manufacture of Oxygen on Gas Works, and the Result of its Practical Application to the Purification of Coal Gas.

By W. A. VALON.

At the meeting of this Institute last June, the author related an account of experiments in purification of gas from sulphur by the aid of oxygen. It is now desired to recount the development of those experiments in actual practice. It is proposed therefore to give:

(1.) A historical summary of the progress made to June, 1888.

(2.) A summary of the development of this progress in its application to every-day requirements.

(3.) The result of the application in actual practice.

(4.) The advantage accruing from the use of oxygen in the purification of coal gas from a commercial, practical and scientific standpoint.

In June, 1888, practical experiments at Westgate-on-Sea had reached a point which affirmed the value of oxygen as an agent for the purification of gas, and demonstrated that if pure oxygen could be brought economically within the gas maker's domain, it could not safely be neglected, and that it was of especial benefit as a purifying agent to those bound by legislation to keep within certain limits of purity as regards sulphur contamination. It will be remembered that attention was, in the first instance, directed to oxygen mixed in certain proportions with the gas and then passed into oxide of iron boxes, no doubt existing that the life of the purifiers so treated, and the advantage gained in luminosity, would allow a large margin, to compensate for the outlay for the comparatively small quantity of oxygen required for complete revivification *in situ*. No disappointment has been experienced in this anticipation, for it has now been proved beyond doubt that where oxide alone is used, economy demands the use of cheap oxygen for revivification. Lime was the next material that received attention in order of investigation; and here was found a still more important application of oxygen than could be claimed in purification by oxide alone. The use of oxygen with lime disclosed perfect and complete purification in closed vessels. These practical experiments proved that when oxygen was mixed with gas and passed through lime sufficient in quantity to remove the carbonic acid (CO_2) it was equal to complete purification from sulphureted hydrogen (H_2S), and also sulphur compounds (CS_2); the latter being abstracted with absolute certainty, without anxiety, and with great simplicity, together with the not least important result that the lime, when exposed, was perfectly innoxious, giving off no unpleasant odor.

During the discussion last year it was suggested that these extraordinary results were perhaps due to area. It was, therefore, determined that investigation should be closely pursued in this direction, that reliable information might be furnished on this point. To do this it was first necessary to decide upon a means whereby oxygen might be manufactured on a cheap and practical scale for everyday requirements on a gas works. Hitherto our experiments had been carried out with oxygen compressed in cylinders, an expensive and prohibitory form when applied to everyday purification. This, therefore, brings me to the second division of my remarks—viz., a summary of the development of the progress made in our experiments in its application to everyday requirements.

In the description given last year of the mode of abstracting oxygen from the air by Brin's process, it will be remembered that a varying temperature was relied upon. In the latter part of the year, however, after many careful experiments, it was determined that oxygen could be made more cheaply with the steel retorts maintained at a constant temperature than by the method heretofore adopted of one alternating between 1,200° and 1,450° F. On this quickly followed the determination to insert the steel retorts containing the barium in ordinary gas retorts, so as to heat them through the walls of those retorts. The mouthpieces and ascension pipes were removed, firebrick rests placed at intervals along the retorts (the steel tubes resting on these), and the entrance to the retorts covered by a cast iron plate, the outside of which was coated with non-conducting material. Four of the 22-inch by 16-inch retorts being equal to a production of more than 2,000 cubic feet, which was in excess of the oxygen necessary for purification, the two bottom retorts were left empty and bricked up in front. The heat was supplied by the furnace that ordinarily supplied heat to the retorts when distilling coal; and finding the desired temperature could be easily maintained in the steel tubes, no doubt remained of the practicability of the plan adopted. The tubes were, therefore, connected up to the pipes conducting the air to them and the oxygen from them. This arrangement, as far as the manufacture of oxygen is concerned, is perfect, and only needs modification in the direction of securing greater economy in the cost of fuel; that is to say, if the steel tubes, instead of being muffled, were set open and exposed to the direct action of heat from the radiation of the flame, greater economy would result, and a larger number could be set in the one arch. The author has, therefore, in contemplation as a permanency an arrangement which, in all essential conditions, excepting the one referred to, will be the same as the first. Where room is an object and space cannot be well spared in the retort house, special producers of the upright type have been designed and are in use at Westminster. These take up but little room, and are very economical in fuel—indeed, unless it be decided on the question of first outlay, in all cases they should have the preference.

It has already been mentioned that the valves are reversed and the tubes worked at a vacuum, in order to draw off the oxygen. To do this at present hand labor is necessary; but an ingenious arrangement for reversing has been devised by Mr. Murray, of Brin's Oxygen Company, which will dispense with the necessity of hand labor, and make the reversal an automatic certainty. This arrangement, in the author's opinion, will give the last touch of simplicity to the making of oxygen, which may be described as practically automatic.

Hitherto my remarks have been confined to an installation where one pump will be sufficient power for pumping and exhausting; an installation on a larger scale, however, requiring two or more pumps, can be arranged to work one-half, or one third, or any desired number of tubes, so that one pump may be constantly pumping in, and the other constantly pumping out, and so save time, with, of course, the usual result that the larger the make the cheaper the production. It should be mentioned that between the air-pump and the tubes are placed a small circular dry-lime purifier, and also a small circular caustic soda purifier. When the pump is set in motion the air is taken from the atmosphere and forced direct through these purifiers into the steel retorts containing the barium for the space of a certain time, the nitrogen escaping by means of a relief-valve. The valves are reversed, and the air that has accumulated in the pipes allowed to escape at a cock left open for the purpose until a vacuum of 25 inches is shown on the gauge. The cock is then closed and the oxygen sent forward to the holder. The holder in this instance has a capacity of only 40 cubic feet, but a larger one is desirable. The holder is connected to a meter regulated to pass the desired percentage to the inlet pipe of the exhauster; the oxygen from this point passing on with the crude gas to the purifiers. In this connection I may mention a proportional meter that has been designed by Mr. W. G. Hicks, of Ramsgate which automatically regulates accurately the percentage of oxygen necessary for purification. This is accomplished by means of a spindle worked by geared wheels attached to the drum-shaft of the station meter. The percentage is regulated by the size of the wheel actuating the proportional meter. These wheels are interchangeable; therefore the percentage may be increased or decreased at will, and the proper quantity of oxygen for purification is thus passed into the gas in accordance with the quantity that is passing into the meter at the precise moment.

On the occasion of the visit of the Southern District Association of Gas Engineers to Ramsgate on 9th May, which has already been reported in the public journals, mention was made of the purifying material when in a half-used state. When the lids were raised from the purifiers to allow of an inspection of the lime, from which the gas had the moment before been shut off in the presence of those assembled, nothing offensive was discernible; but such an experiment tried during the progress of ordinary purifying operations would have been impossible without impregnating the whole neighborhood with offensive odor. To make the trial as searching as possible, men were immediately employed to throw the lime on each side until the bottom of the purifier was exposed to view. Some of the members then descended into the mass without inconvenience or discovering anything unpleasant. The purifier was left thus uncovered until next morning, when the lime was again inspected by several gentlemen who had stayed behind, among others, Mr. James W. Helps, Engineer to the Croydon works; and in their presence the lime was readjusted on the grids, the lid lowered, and the purifier again brought into use, the lime remaining active, doing work in purification, for another 25 days before it was finally thrown out of use, although then not wholly spent, having passed 7,000,000 cubic feet after it was first inspected. This purifier was finally opened in the presence of Mr. Henry Hack, of Birmingham, who was at Ramsgate on the 3d and 4th June, making a critical examination of the whole process; and the tests taken by this gentleman showed that at the time the purifier was shut off there was 630 grains of H_2S and 746 grains of CO_2 in the crude gas. The outlet of this purifier showed 555 grains of H_2S and 650

grains of CO_2, proving that it was still active for purification to the extent of taking out 75 grains H_2S and 96 grains CO_2.

The four purifiers are supplied with such valve connections as would render it impossible to use them for ordinary lime purification. They were designed and used for oxide purification only, three being in use at one time, and the fourth kept ready for action when required. By using oxygen, the same arrangement is maintained. The gas is admitted into No. 1, passed on through No. 2, and finally through No. 3 on to the gasholder, one being kept in reserve, ready for use in its turn. When No. 1 is done, No. 2 becomes No. 3; No. 3, No. 2; and No. 4, No. 3. No. 1 being cleared and recharged, the same order commences again and is continued. The test for foulness is carbonic acid (CO_2) in equal quantity at the outlet as at the inlet. The test by Sheard's apparatus is rendered a simple one, taking but a few minutes of time. This test should be made on the first and last purifier—the first to make sure the lime is perfectly inert, and the last to avoid passing unpurified gas. This latter event is made impossible by always keeping a completely clean purifier in front of the one that shows the slightest trace of foulness at its inlet; and this again is rendered doubly practicable by the fact that the presence of oxygen so intensifies and quickens the action of the material, and so greatly shortens the time of contact necessary for perfect purification, that the operation is only spread over one-third of the area usually required in ordinary lime purification. The size of the purifiers is 14 feet × 14 feet each. The second in the series was the first brought into use as No. 1, and remained in action 40 days, being finally thrown out, passing during that time over 9,000,000 cubic feet. These three purifiers were each charged with twelve yards of slacked chalk lime, not 60 per cent. of which was caustic. Two of these were brought into action at one time. For the first six days no impurity (either sulphur or carbonic acid) was visible at the outlet of the purifier used as No. 1. On the seventh day there was 98 grains carbonic acid (CO_2), and 140 grains of sulphureted hydrogen (H_2S); the inlet at foul main showing at the same time 790 grains carbonic acid (CO_2), and 600 grains sulphureted hydrogen (H_2S), and the sulphur in other forms in the purified gas was under 6 grains. On the seventh day, therefore, the purifier used as No. 2 commenced to work, and no carbonic acid (CO_2) or sulphureted hydrogen (H_2S) was found at the outlet of this purifier until the fourteenth day. Therefore it was not until the fourteenth day that the purifier used as No. 3 commenced to do work; and this purifier, twenty-nine days after No. 1 commenced working, gave 5 grains of sulphureted hydrogen (H_2S) at its outlet, and not a measurable trace of carbonic acid (CO_2), No. 1 not yet being quite exhausted, having passed more than 8,000,000 cubic feet. Thus the gas purified from all impurities—viz., carbonic acid (CO_2), sulphureted hydrogen (H_2S), and sulphur compounds (CS_2),—to June 3, was equal to more than 500,000 cubic feet per yard of caustic lime. The total sulphur in the purified gas did not at any time exceed 8 grains per 100 cubic feet, while the proper proportion of oxygen was admitted and ordinary purification was not interfered with for other experimental purposes.

Now, these facts prove beyond doubt:

(1.) Instantaneous action of oxygen.

(2.) Fixity of the sulphur in the lime.

(3.) That with oxygen a greatly reduced area is required.

(4.) Economy in lime.

(5.) Economy in labor.

(6.) Simultaneous and perfect purification from carbonic acid, sulphureted hydrogen, and sulphur in all forms.

(7.) Easy and absolute control of the sulphur compounds without trouble or anxiety.

(8.) Complete immunity from anything objectionable whilst carrying out the operation.

To fully understand the importance of this statement, let us suppose we desire to purify the Ramsgate gas by the ordinary lime process; how would this affect the purifying space? First, there must be at least three carbonate boxes, two sulphide boxes, and four iron boxes—just double the number of boxes at present in use for lime with oxygen—and it is needless to say they must be of considerably increased area, otherwise the extravagance in lime used would be ruinous. I think this finally disposes of the area question raised quite rightly last year as a point that needed consideration and decision—indeed, it was suggested during the discussion of last year's paper as a possible answer to the extraordinary experimental results obtained at Westgate, that they were secured by the assistance of undue area, impracticable in general practice. To accentuate this point, so that it may not be raised again in the future, the author would remind you that the make of gas at Ramsgate is approaching 120,000,000 cubic feet per annum, and last winter, when depending on oxide purification alone, and admitting 1 per cent. of air, one of these 14-feet boxes was changed daily.

The carbonic acid in the Ramsgate gas averages, after scrubbing and washing, a trifle under 1 per cent., and the sulphureted hydrogen, after receiving similar treatment, averages 600 grains per 100 cubic feet.

An important point was also raised with regard to the effect of air on the illuminating power of coal gas, when used as a purifying agent, and also an equally important point as to how far air in purification can be made to do the work of pure oxygen. Now, with regard to the first of these points, the author made careful investigation, detailing the result plainly in the paper read last year; and these results were as close as may be with the teaching and practice of the last 30 years. Several speakers, however, ignored the effect of air on illuminating power, asserting that a certain percentage used in the purification had no deleterious effect on the luminosity. Special attention was therefore directed to determine this contention, with the result of giving an emphatic repetition of last year's experiments, and showing a previous under-stating rather than what should have been recorded. The following is the accurate result of further investigation:

Prior to using oxygen at Ramsgate, oxide of iron was wholly depended upon for sulphur purification, lime purification under ordinary conditions being rendered impossible by reason of area and number of purifiers, as well as the ruinous effect on a town used as a health resort by the nauseous smell engendered while changing ordinary lime purifiers. I am able, therefore, to state positively, from returns made from day to day, that the illuminating power of the gas at Ramsgate has averaged for years past, with oxide purification and 1 per cent of air, 13.5 candles, the coal used being Pelaw Main, and the make over 10,000 cubic feet per ton—the additional two candles required to raise the illuminating power to 15.5 being made up with about 2½ per cent. of cannel, the cannel used being New Boghead or Tyne cannel. Now, since we changed over to lime and oxygen, the illuminating power has ranged between 16.5 and 17.3 candles, and no cannel has entered our retorts. Special attention was called to this fact in my paper read before the Southern District Association of Gas Engineers on the occasion of their visit to Ramsgate on May 9, and it was abundantly proved during the day, the illuminating power and purity being both tested at the author's request. Therefore, allowing that the increase of one candle is due to the removal of the 1 per cent. of carbonic acid by the lime, it leaves 2½ candles to the credit of the use of 0.6 per cent. of oxygen, and the discontinuance of 1 per cent. of air. It was thought desirable, however, that the effect of oxygen as against certain percentages of air on illuminating power should receive some further confirmation. A gasholder was therefore set aside to receive the gas treated with air at 2½, 3, and 5 per cent. respectively. Each percentage was allowed to act on the whole of the gas made for twelve hours—that is to say, the 2½ per cent. was passed into the gas before entering the lime boxes for twelve hours, and conducted to a separate holder shut off for the time being from the district. After the gas had been stored it was tested; the holder was then cleared, and the next experiment proceeded with under similar conditions to the first. The recorded effect on the illuminating power, as compared with that obtained while using oxygen, was as follows:

2½	per cent.	lowered	the	illuminating	power	to	13.45
3	"	"	"	"	"	"	13.04
5	"	"	"	"	"	"	10.59

The gas in the large holder supplying the district was 17 candles when the experiment in each case was commenced; and half an hour after the completion of each experiment, when oxygen had again taken the place of air, the illuminating power rose to the normal 17 candles. Nothing could therefore be more conclusive as to the detrimental effect of air on illuminating power than this trial.

As it will be seen, these experiments are entirely confirmatory of those made at Westgate, but on a more extensive scale, and therefore more conclusive; but if the practice and theory of the last 30 years are to go for anything, these results must have been anticipated—indeed, on comparing them with those given in King's Treatise, Newbigging's Handbook, and Lewis Thompson's observations, made a quarter of a century ago, they are so nearly identical as to fully corroborate each other. The air in these trials was admitted at the hydraulic main and drawn through the foul main running round the whole course of the retort house with fine wire screens inserted at frequent intervals, through which the gas must pass, giving every opportunity for the carbureting of the nitrogen before reaching the gas holder, if such a thing were possible. But, indeed, it stands to reason that it cannot be carbureted, for if it is necessary to remove the ordinary crude gas, which is a good carrier of hydrocarbons, from contact with the tar at the earliest possible moment for fear of their absorption, how is it possible

for hydrocarbons to be taken up as well as carried by nitrogen, which is a bad carrier, anxious to rid itself of what would be a burden at every opportunity? It has been asserted, in the hearing of the author, that 4 per cent. of air may be, and is, used in certain works with good effect and without detriment to luminosity. This statement, however, is directly at variance with carefully conducted experiments and past experience, and can only be established by a direct and incontrovertible reference to the actual data on which it is founded.

This brings me to the second point raised—viz., How far air can be made to do the work of pure oxygen in purification. You have already had described the mode of proceeding for testing for illuminating power whilst air was passing; at the same time observations were made on the effect produced on the lime. It will be remembered that the foul gas contained about 1 per cent. of carbonic acid and about 600 grains of sulphur, and as 0.10 per cent. of pure oxygen is necessary to add to the gas for every 100 grains of sulphur, it follows that the 3 per cent. of air would contain the necessary quantity for purification; but mark the result, as already stated, the moment before admitting the 3 per cent. of air, 0.6 of oxygen was passing into the gas (this being equivalent to the quantity of oxygen that is contained in that quantity of air). In a very short time the second purifier showed considerably more impurity at the outlet than the inlet, the sulphur measured in was 620 grains, measured out it was 830. Before the end of the day the fourth purifier, not before in use, had to be requisitioned, and in a few hours more this would have been insufficient to keep the sulphur back; and as we had no more purifiers to use, air was discontinued at the end of twelve hours, in time to prevent sulphur entering the clean gas. The carbonic acid maintained its position in the purifiers, but the bisulphide rose at the outlet of the purifiers to 20 grains. When using 5 per cent. of air under similar circumstances, the results were analogous, excepting that the sulphureted hydrogen did not go forward at quite such a rapid rate. These last experiments prove beyond doubt the value of oxygen over any possible system of air purification in economy of space, lime, and labor.

Many engineers have verbally, and by letter, asked the author: "Can you give a satisfactory reason, apart from its effect on illuminating power, why air, being a mechanical mixture, does not do the work equally well with pure oxygen?" This is a difficult question, and has received lengthened consideration. It is certain that the transformations taking place in the purifiers are instantaneous, and are due to the rapid oxidation of the lime, and this rapid oxidation is only set up by the action of the oxygen in the absence of the nitrogen. This is shown clearly in the experiments already recounted. An explanation may be found by comparision, thus: A flame 3 inches long, when burned in air, would (all things being equal except the oxygen) be reduced to less than 1 inch burned in an atmosphere of pure oxygen, the intensity of the light being correspondingly increased. Again, take iron smelting. Iron may be exposed to heat in quantity for an indefinite time with the result of its temperature being scarcely raised to a dull red; but it may be that one-tenth of that quantity applied in intensity would do the work of melting it. Look again at the method here described for abstraction of oxygen from air by passing it through heated barium. We know of no substance with a greater affinity for oxygen when placed under favorable conditions. In practice, however, we find that only one-tenth of the total oxygen is absorbed in passing. These illustrations may go some way to explain why air will not do the work of pure oxygen. To use the simile of the heated iron, in the author's opinion it can never in any form go beyond "dull redness" in purification.

We now come to the fourth division—viz., the advantage accruing from the use of oxygen in the purification of coal gas studied from a commercial, practical, and scientific standpoint. Although the author is aware of the necessity of discussing the commercial point, in order that the great advantages of the use of oxygen may be made as patent as possible to all, still he would say at the outset what was said last year—that every engineer can best estimate these advantages for himself, in accordance with the circumstances that surround him. One engineer may just have laid down extensive purifying plant, and space to him may not at present be an object of consideration, and another may not be under the operation of the Sulphur Clauses Act (which those who are known to be, with the present mode of purification, a grevious burden), and is satisfied to rely on oxide purification alone for sulphur purity; and in these cases of unlimited space or absence of obligation engineers may be disposed to rely on a limited supply of air, and may think the use of oxygen with them is not a necessity and can be dispensed with. But the author would assert that even under these favorable circumstances avoidance of the use of cheap oxygen is an unjustifiable extravagance. This will lead directly to the question: What is the cost for the manufacture of oxygen on a gas works for purification? You have heard described the simple method by which oxygen is produced at Ramsgate; and many here have seen the plant in operation; but to those who have not seen it, the difficulty will be to convey to them, in a sufficiently clear manner, the real absence of cost, while giving the positive side of absolute cost.

The permanent arrangement previously described is the one favored for a gas works, which would necessitate the clearing away of a bed of clay retorts to make room for the steel retorts. The maximum make of oxygen from this number of steel retorts should be 10,000 cubic feet in twenty four hours, enough to purify about 2,000,000 cubic feet of coal gas. They are so arranged as to allow of the withdrawal of such tubes as are not required; and they could be reduced in number so as to leave the top tier or two top tiers as the case may be. The life of the barium with which these tubes are charged is a long one, and the consumption of fuel is the most important question; but this is not great, seeing that the highest temperature is under 1,450° Fahr., and the work it does is of the lightest. These remarks are necessary, otherwise the bare statement of the actual consumption of fuel for heating these tubes without the explanation would appear fallacious. The fuel consumption at Ramsgate by the extravagant plan first described, rendered extravagant by enclosing the tubes in muffles, is 6 cwts. per day; and at Westminster, where producers of an upright type are used, containing tubes without muffles heated by furnaces designed by the author, the consumption of fuel is only 4 cwts. per day to produce a much larger quantity of oxygen. These upright producers are found to be much more economical in fuel than where the tubes are placed horizontally; and if they can be conveniently introduced, they will pay for extra cost in construction. The author has in his mind, however, the adaptability of existing gas works plant to the manufacture of oxygen, and in that light a few bushels of coke more or less used in the retort house before it is handled for sale cannot be a serious item. The coke for raising steam to drive the pump may be taken at the same quantity as for heating the retorts, the same boiler making steam for the engine driving the gas exhauster.

The first cost of oxygen plant, including pump, retorts, purifiers, oxygen holder, etc., complete, will average from £5 to £10 per million, according to the size of the works, and even less than the lower figure where the works are large. The wear and tear is confined principally to the steel tubes containing the barium, and the air pump and its belongings It will be noticed that all the covers and pipes of the steel tubes will last a lifetime, and can be transferred from one steel tube to another as the body is destroyed. These bodies are not costly—about 50s. each. It will be clear to every gas manager that a tube worked at so low a temperature as 1,450° will not soon be destroyed. If, however, this should occur twice a year, which is not probable, renewals would be but a small item. It is possible, too, that experiments now being practically tried with cast iron may prove successful, in which case the life of the tubes would exceed those of clay retorts. When renewal becomes necessary, one is drawn out and another substituted in its place without disturbing its neighbor. The oil for air pump, wear and tear, and the attention it needs, may be looked upon as one would look upon an extra exhauster.

The author hopes he has made these details clear; if so, it will be agreed that after having made the first outlay for plant, and ascertained what is the cost of the space occupied in the retort house, the maintenance, fuel, and labor, mean very little, and cannot average more than from 1s. 6d. to 2s. 6d. per 1,000 cubic feet of oxygen, according to the size of the works requiring it—indeed, the operation so fits in with the every-day routine pursued in a gas works that it is difficult to fix the figure at even this low cost. It may therefore be safely asserted that great economy will result from the use of cheap oxygen in purification by its application to oxide of iron. The absence of the necessity for periodically opening the boxes (excepting where one may get hardened, and which can be loosened *in situ*); the avoidance of a shift of material from month's end to month's end until the material is fully spent and charged with 20 or 30 per cent. more sulphur than can possibly be put into it in any other way; the increase of illuminating power which is undoubted as between air and a proper proportion of oxygen, and the immense saving in space from its intense and certain action, must leave a very large balance in its favor even in oxide of iron purification only.

In the case of lime this is still more marked—indeed, such is the perfection of lime purification with oxygen that oxide of iron purification pure and simple may be regarded in itself as an utterly unnecessary and wasteful process, as by means of 50 per cent. of the lime at present needed, the carbonic acid, sulphureted hydrogen and sulphur compounds are wholly removed without trace of nuisance. It is therefore clear that lime and oxygen purification, as far as labor and material are concerned, taken as a whole, cannot exceed the cost of the present system,

leaving every other advantage in space, purity and economy to the credit of oxygen.

The following figures will demonstrate this still further: On reference to Field's Analysis of the principal gas undertakings in England, Scotland and Ireland, the average cost of purification where companies are placed under the Sulphur Clauses Act, is £3 15s. per million cubic feet.

This same work, in conjunction with the oxygen in purification, but not including the cost of the oxygen, is	£1 15 0
Cost of 0.6 per cent., or 6,000 cubic feet of oxygen at the higher figure of 2s. 6d., which includes all cost except interest on outlay for plant	0 15 0
Interest on capital in providing oxygen plant at £10 per million at 10 per cent.	1 0 0
	£3 10 0
Balance in favor of oxygen	£0 5 0
Add interest on capital due to saving of one-half the space and plant required under present system—viz., £50 per million, at 7½ per cent	3 15 0
Add the average cost of 1½ candle in illuminating power, at 1d. per candle; or if the average cost of cannel to maintain the illuminating power of gas obtained from ordinary caking coal at 16.5 be taken, it will amount to the same figure—viz., 1½d. per 1,000 cubic feet = one million at 1½d. per 1,000	6 5 0
Saving per million cubic feet	£10 5 0

Now, if the center item of £3 15s. be excluded by any engineer, because in his case extension of plant may already be in existence, it still leaves to the credit of oxygen £6 10s. per million cubic feet.

The economies of oxygen purification have been designedly understated, the saving claimed having been greatly exceeded at Ramsgate. It is sufficient for the author's purpose to make it clear that the system is self-supporting under all conditions where gas must be purified, and leaving such a margin as to recommend its adoption by all gas companies and corporations.

In conclusion, the author would for a moment refer to the evidence given before the Parliamentary Committee appointed to inquire into the sulphur question in 1877. It is difficult to harmonize the evidences then given with what is now said as to the impossibility of complete sulphur purification in and about London without creating a public nuisance of an unbearable kind; and the author thinks the limit of sulphur is placed by the referees unnecessarily high in deference to the opinions in 1877 expressed, which were held, and it may be rightly, if dependence must be placed wholly on the sulphiding process, or on the use of a limited supply of air: but in the future oxygen purification, perfect in itself, will allow companies and corporations to comply with every demand made by the Legislature to compel the supply of an article of as great purity as is practicable. The process now described being simple, scientific, less costly, and without nuisance, recommends itself to every engineer; and the author leaves with confidence the future of oxygen purification in the hands of his professional brethren.

The Reactions Involved in the Calcination of Portland Cement.

Mr. B. H. Thwaite, C.E., contributes to the *Builder* the following interesting notes, on the syntheses of the reactions involved in the calcination of Portland cement, the same being based on Le Chatelier's researches.

Our authority, having delivered himself of the opinion that no scientist has applied scientific reasoning to nor analyzed the development of the various actions occurring in many industrial processes with more thoroughness than Chas. Le Chatelier, goes on to say:

In the calcination of Portland cement, the first effect is the expulsion of the water at 100° Cent.

The next effect is the decomposition of the clay at a temperature of 600° Cent., and its dehydration.

Between 800° and 900° Cent. the calcic carbonate is decomposed with the expulsion of the carbon-dioxide (CO_2). The calcic carbonate is then converted into quicklime.

This is an important phase in the calcination. Immediately the carbon-dioxide leaves the lime the influence of the contact with the clay is accelerated, and the two agents, lime and clay, combine—the combination becoming more complete the higher the temperature, and the more it is prolonged.

The grains of lime and particles of clay form fusible amalgams of two kinds; one having a basic preponderance, the other an acid one. In any amalgam constituted of a piece of imperfectly calcined clinker, the center will be found to consist of the clay constituents, silica and alumina. Around this will be melted glass, or an excessive preponderance of clay, in a mixture of the clay and the lime. Next to this will be a melted mixture of the double silicates (silicates mono and dicalcic), both fusible at the ordinary temperature of calcination of the cements. Next to this last amalgam, and forming the more perfectly burnt part of the clinker, are the silicates of lime, the silicates tricalcic (infusible), and the aluminates of limes (fusible), and, finally, the quicklime.

The proportion of these various elements varies continually with the degree of advancement of calcination.

If there is a very considerable excess of the lime agent, the final product of calcination will be the silicate tricalcic and aluminate tricalcic along with quicklime—if the proportion of lime is not in excess—the quicklime will be absent if less lime is used, the calcic illuminate will disappear, and will be replaced by a double silicate, analogous in its composition to blast furnace slag.

If the proportion of lime is further diminished, the silicate tricalcic will disappear, and be replaced by the silicate dicalcic, and a further calcic reduction will convert the silicate dicalcic into the silicate monocalcic.

The following table illustrates the influence of an excess of lime on the character of Portland cement:

Normal Cement.			Excess of Lime.	
S_2O^3 = 1.00	1.21		1.00	1.17
Al^2O^3 = 0.21			0.17	
Fe^2O^3 = 0.04			0.03	
CaO = 3.29			3.71	3.76
M_gO = 0.08			0.05	
$CaO.SO^3$ = 0.015			0.01	
Bases.. 3.37			3.76	
	=2.78			=3.2
Acid... 1.21			1.17	

The analyses of cement should show that the cement has an excess of lime, or more than three equivalents of protoxide ($CaOM_gO$) to one equivalent of acid ($SiO^2Al^2O^3$).

What Pyrometers Are.

The methods employed for the determination of high temperatures—the temperature of furnace fires, flue gases, molten metals, etc.—may be divided into four classes: (1) Those which depend for their indications upon a change of dimensions of a body employed in the test; (2) those based on the amount of heat imparted to a body of water or air by the heated body; (3) those depending upon the melting points of metals and metallic alloys; and (4) those dependent upon the measurement of the electrical resistance of metals.

The first method was employed by Wedgewood, who constructed, in 1782, the first instrument by which high temperatures could be measured with any approach to accuracy. His instrument is based on the property possessed by clay to contract when exposed to high heat, an effect which is believed to be due partly to the loss of its water, and partly to the process of vitrification which sets in subsequently. It has been found, however, that the assumption by Wedgewood that the contraction of clay is proportional to the degree of heat to which it is subjected, is incorrect; and that a long-continued heat of moderate intensity will cause the same amount of contraction as a more intense heat for a shorter time; and, further, that different clays differ considerably in the degree of contraction which they suffer when subjected to the same temperature. For these reasons the method of Wedgewood has been abandoned in scientific measurements, as unreliable, although it gives results in many cases approximating sufficiently to the truth for all practical purposes.

In the pyrometer of Daniell the temperature is measured by the expansion of a metal bar inclosed in a black-lead earthenware case. The metal of the bar is either platinum or soft iron. The expansion of the bar causes the motion of an index of porcelain on a suitably-graduated scale. The second method, which is that most generally in use in metallurgical operations, consists in placing a mass of platinum of known weight in the medium whose temperature is to be ascertained, and when it has acquired the same temperature, plunging it into a body of water of known weight and temperature. From the indicated rise of temperature of the water, the known relation between the weights of the platinum and the water, and their relative specific heats, the data are given for the estimation of the temperature to which the platinum was originally heated.

A method similar in principle to this is in common use to determine the heat of furnace and flue gases. It is based on the plan of mingling with the heated furnace or flue gases a definite volume of air of known temperature, the assumption being that if an equal volume of air is mingled with the hot gases, their temperature will be reduced one-half; if twice the volume, two-thirds; if three times, three-fourths; if nine times the volume, nine-tenths, etc. By thus mingling a large volume of cold air with the hot gases the temperature of the mixture will be reduced sufficiently to permit it to be measured by means of thermometers, or by the expansion of a metal bar.

The third method, based on the melting points of certain metals and alloys, is practiced by simply suspending in the heated medium a piece of metal the melting point of which is known, or, if necessary, several pieces of different (but known) melting points. According to the observations of the pieces which are melted, and those which continue to remain solid, the temperature of the medium may be ascertained within a very narrow limit of error.

The fourth method is a much more refined and scientific one, devised by Siemens, and is based on the principle that the electrical resistance of metals stands in a certain relation to the temperature, an increase of the latter causing a corresponding increase of resistance. The resistance of a given piece of metal of known material and dimensions being ascertained by measurement with the aid of suitable apparatus, its resistance for any given temperature can be calculated, and *vice versa*. This treatment will be found described in the special treatises on electricity.

On Gas Engines, with Description of the Simplex Engine.

[A paper read before the Institution of Civil Engineers, by Edward Delamare-Debouteville, Rouen, France.]

Historical.—Nearly a century has elapsed since the appearance of the first definite description of a gas engine; and many years passed before this ingenious idea was practically developed into a working machine. No sooner had the first gas motor become an accomplished fact than improvements rapidly suggested themselves, and contributed to insure its success. It is not intended to review in detail the numerous inventions relating to gas engines; but it will be of interest to note those which have been conspicuous by the importance of their results.

From 31st October, 1791, when John Barber published the first description of a gas engine, until 24th January, 1860, when Lenoir brought out his well-known arrangement, 38 patents were taken out in France and elsewhere; and in glancing through these old documents it is surprising to recognize in them all the ideas which are supposed to have originated only yesterday, besides others which may turn out to be the success of to-morrow. Nevertheless, each year gives rise to ideas that are new in their application, even if not novel in themselves. Such efforts cannot fail to result in a radical change of the former plans.

Up to 1860 the various inventors may be said to have worked in ignorance of one another's doings, and their designs clearly show that their ideas were original with themselves, and that efforts were directed not to the improvement of previous inventions, but to the search after combinations which they supposed to be new. But when the first gas engines were got practically to work the new ideas followed the current of the time. The inventors who followed Lenoir set themselves to improve the double-acting engine; now they are endeavoring to apply the four-cycle plan of Beau de Rochas. Is this arrangement likely to be final? Will no better plan be discovered for rendering the gas engine a successful rival of the steam engine? As yet it is impossible to answer so intricate a question; but pending some radical change it is possible to improve existing engines, and to simplify their construction and working. Until very recently the gas engine has been specially applied only where small power is required; its application for such powers as have hitherto been considered the province of steam is reserved for the future. A rapid examination of the most important inventions since 1791 will enable a notion to be formed of what has already been done, and what still remains to be accomplished.

At that date gas was not an industrial product, and accordingly John Barber described what he considered the best processes for its production. He proposed to distill coal, wood, oil, or other combustibles in a retort, and then by means of a pump to inject the product into a cylinder where explosion takes place. A second pump injects air in suitable proportions, and ignition is effected by the flame of a match or candle. To avoid excessive heating, he proposed the injection of water by a pump. Although Barber's machine could never have been a practical success, it is interesting as the first idea of an engine driven by explosive gas.

Three years later Robert Street described a gas engine consisting of a cylinder and piston, with a slide-valve containing the flame for igniting the explosive mixture, which he produced by allowing a few drops of oil of turpentine to fall on the bottom of a cylinder superheated by a stove, while the piston, raised by the flywheel, sucked in air, and the latter combining with the vapor of turpentine rendered it explosive. The flame in the slide-valve ignited the mixture, whereby the motive power was produced.

William Barnett's invention, under date of 18th April, 1838, marks an important step in the history of gas engines. He describes three kinds of motor, the first single-acting and the second double-acting, whilst the third and most interesting is on the compression principle. In this last the gaseous mixture was admitted on both sides of the piston. Two pumps, driven at twice the speed of the motor, compressed the air and gas separately, and the compressed air and gas were mixed in the cylinder at the end of each stroke, and were then ignited. A third pump was used for clearing the cylinder of the burnt gases after their expansion. It is in this arrangement that the advantage of compression is first clearly pointed out, and to this novelty must be added the method of ignition also. Recognizing the difficulty of igniting an explosive mixture in a state of compression, Barnett proposed to use a hollow cock containing a gas burner. This cock has a revolving movement, whereby in one position it brings the burner into contact with an external flame which ignites it, and in its further motion shuts it off from the external air, and brings its flame into contact with the compressed gas in the cylinder. This mode of conveying the flame certainly could not insure a regular ignition, but it marks the first step in that direction, and on this account is worthy of notice.

John Reynolds, in 1844, proposed an electric battery, the current from which was to heat a platinum wire to incandeseence, and thereby cause ignition. A contact breaker transmits the current at the instant required.

Shepherd, in 1850, used an electro-magnetic machine for igniting the mixture.

Eugene Barsanti and Felix Matteucci, in 1857, described an atmospheric motor, the precursor of the well-known Otto and Langen engine, which it closely resembled in external appearance, although as a practical success it was by no means all that could be desired. The only detail worthy of special notice is the employment of a Bunsen battery, connected with a De la Rive multiplier, the sparks from which caused the ignition. Subsequently, in the Lenoir engine, the De la Rive multiplier was replaced by a Ruhmkorff coil.

In 1858 and 1859 Degrand gave descriptions of a whole series of engines of different types, and in particular a four-cycle compression engine is minutely specified; but, unfortunately, the mechanical details which he proposed to employ are not of a practical nature.

This brings us to 1860, which will always be a remarkable year in the history of gas motors. Early in that year Lenoir brought out the first commercially successful gas engine, of which he may therefore be fairly considered to be the first actual inventor. His engine is too well known to require any detailed description; but it is interesting to remark that in its final form it embodied six successive additions to the original invention, and it is only by studying this long course of improvements that the ingenuity of the inventor and the merit of his invention can be fairly appreciated. Unfortunately, he did not reap the full success which his invention deserved, its two chief drawbacks being a defective mode of ignition and an extravagant consumption of gas.

No sooner was Lenoir's engine brought to public notice than it became the subject of a lively discussion, not only in regard to its practical advantages and disadvantages, but especially as concerned the scientific conditions of its working. A fresh stimulus was given to inventors, but their efforts were no longer confined to fresh combinations of details more or less novel, but were directed to new conditions of working. Many fresh cycles of operation were suggested, but their description in detail would be too lengthy. One specification, however, is worthy of particular notice, not only on account of its special bearing on the subject of this paper, but also for the remarkable clearness with which the scientific conditions of a rational mode of working are laid down, and the precision with which the author has stated in detail how the conditions required to attain the most economical result are to be realized.

In 1862 Mr. Beau de Rochas published a specification dealing in detail with several scientific questions. Those only which relate to the gas engine will here be considered, but as fully and completely as possible. The theories broached by him have already led to remarkable results in practice, and a more careful study of them will probably be repaid by many further improvements. Neglecting the non-compression motor, we come at once to that in which compression is adopted; but before

proceeding to describe the arrangements by which he proposes to fulfil the conditions theoretically required, Mr. Beau de Rochas lays down the law that there are four such conditions necessary to realize the best results from the elastic forces of gas: (1) the cylinders should have the greatest capacity with the smallest circumferential surface; (2) the speed should be as high as possible; (3) the cut-off should be as early as possible; (4) the initial pressure should be as high as possible.

(1) For a given expenditure of gas the greatest diameter of cylinder will correspond with the most effective utilization of heat. Therefore, whenever possible, only one cylinder should be employed for each distinct motor.

(2) But time is a factor in the dissipation of heat. Other things being equal, the slower the speed the greater will be the loss of heat. For the same power a greater speed means a smaller cylinder; but the antagonism between this and the last-named condition vanishes if it is remembered that for a given expenditure the proportion between the stroke and the capacity of the cylinder need not always be the same.

(3) In a gas engine, just as in one actuated by steam or other elastic vapor, the greatest range of expansion gives the best result. But under the conditions last stated the maximum range is limited by the circumstances of each special case. Therefore, that arrangement which allows the freest range of expansion, or, in other words, which permits the earliest cut-off practicable, will give the best result.

(4) Lastly, the utilization of the elastic force of gas depends on another element connected with the advantage of a high grade of expansion. This element is the pressure, which, to give the best result, should be as high as possible. It is evident that it is a question of expansion in a heated state after compression in a cold state, or of increasing the expansion by a method inverse to that which consists in creating a vacuum. Such an inverse method would not be applicable to steam, since all compression must involve a corresponding condensation; so that, even if steam were combustible, instantaneous heating would thereby be rendered impossible.

The fundamental idea of Mr. Beau de Rochas is thus clearly seen to consist in the compression of the gaseous mixture to the greatest extent practicable before ignition. Manifestly the only way to do this is to to use a single cylinder—first, on account of the advantage of having as large a one as possible, and, next, to minimize the resistances of the mixture. Consequently, for one end of the cylinder, the following sequence of operations takes place during four consecutive strokes: *a*, inspiration during an entire stroke; *b*, compression during the second (return) stroke; *c*, ignition at the dead point and expansion during the third stroke; *d*, expulsion of the burnt gas during the fourth (return) stroke. This engine, he claims, fulfils the condition of the largest possible cylinder, and the still more important condition of initial compression. Moreover, the speed of the piston in proportion to its diameter is the greatest possible, since the work usually performed in two strokes is accomplished in one.

In 1863 Mr. Hugon brought out his motor, in which ignition was effected by a gas flame controlled by a slide. The arrangement was ingenious, but the motor had only a moderate success.

In 1867, at the Paris Exhibition, Messrs. Otto and Langen brought out their atmospheric motor, bearing a strong resemblance to that of Barsanti and Matteucci. Its construction was ingenious, and its working a practical success. The rack and clutch motion was worthy of special notice, the slide-valve was ingenious, and the increased economy of consumption considerable; but its working was both noisy and violent. A description of this engine was given to the Institution in 1875.

The Bischoff motor appeared in 1870, but its success was confined to engines of a very small power, of which a large number were made. It would probably have been still more extensively adopted had it not been for the Otto engine, which was brought out six years later—in 1876.

Dr. Otto's inventions were two in number. The first, in 1876, related to two kinds of engines, one without and one with compression; while the other, in 1877, had reference to improvements in the slide-valve and other details of the compression engine; and this type of engine alone need now be discussed, as at the present time the non-compressing engine may be considered to be abandoned, on account of its excessive consumption. The fundamental idea of the engine is based on the four-cycle principle of Beau de Rochas, already described. In connection with his 1876 invention, Dr. Otto enunciated a special theory, which has been called the theory of the threefold mixture. The mixture was composed, firstly, of a portion of the products of combustion from the preceding stroke; secondly, of a modicum of pure air allowed to enter at the commencement of the admission; and, thirdly, of a combustible mixture of air and gas admitted afterward. This threefold mixture resulted in a less violent explosion, a successive combustion of one molecule after another, more regular and more silent working, and great economy in consumption. This theory, which, owing to the limited knowledge of the subject at that time, was accepted without question, can no longer be admitted, as its fallacy is demonstrated by every-day practice. As these theories have been refuted by the most competent authorities on the subject, they may be passed over; but though Dr. Otto has thus been unfortunate from the scientific point of view, from a practical point few inventors have achieved so decided a success, and for many years he was the only maker of gas engines.

The Otto engine is so well known to engineers that any detailed description, beyond the general fact that it is a single acting motor on the four-cycle principle, would be superfluous; but the method of ignition as described by him in 1877 requires a more careful study: and a critical examination of this, and of the more important of the methods previously used, seems indispensable to the present subject, as the improvements introduced by the author were the direct outcome of a similar study.

Slide-Valve.—The arrangement for ignition in the Otto engine consists of an external flame placed against the cover of the slide, and of a port pierced in the bottom of the cylinder for the admission of the gaseous mixture, and for its ignition; above this port is another small hole by which an equilibrium is maintained between the gases in the cylinder and those in the slide. On one side the slide carries a spreader for effecting the intimate mixing of the gas and air, and in its central part a chamber where ignition takes place. By a special arrangement this chamber is filled with a mixture of air and gas in suitable proportions, the slide is moved, the interior chamber is exposed to the external gas burner, and its charge ignited. As the speed of the slide is suitably proportioned, the flame in its cavity is carried forward and communicated to the compressed mixture in the cylinder. It will of course be understood that by this movement of the slide all communication with the outer air is now cut off, so that the flame in the ignition cavity is protected from any external influence.

If this momentary flame were at once brought into contact with the compressed mixture, it would be blown out by the violent current set up; but this is avoided by an ingenious arrangement. The small hole previously mentioned, which is situated in the slide face at the bottom of the cylinder, is slightly in advance of the port proper, so that it comes line and line with a similar hole in the valve itself before the port is uncovered. This second hole forms a communication with the interior of the ignition chamber, so that a minute volume of the compressed gases from the cylinder entering thus into an enlarged space is partially expanded, and revives the inner flame when just at the point of extinction. At this instant the port of the slide comes line and line with that of the cylinder, and as the pressure of the ignited mixture in the cavity of the slide has been thus progressively but considerably increased, there is no fear of its extinction, or of its failing to ignite the charge in the cylinder. As an additional precaution, the orifice at the bottom of the cylinder is filled, by a special arrangement, with a mixture richer in gas, and it is by this richer mixture, containing none of the products of combustion of the previous stroke, that the interior flame is reinforced, as has just been described.

This system, however, is very complicated; it depends on numerous orifices which become rapidly incrusted, owing to the flame which fills them at the moment of ignition; a layer of carbon is deposited on their inner surfaces, and soon attains a considerable thickness. To ensure the equilibrium of pressures with sufficient delicacy the cut-off edges must be adjusted to a small fraction of a millimeter, and however accurately this may be done at first, it is soon modified by the incrustations above named, which must be frequently removed, if the best result is to be obtained. In addition, the slide, reduced as it is in thickness by the interior cavity, is easily buckled by the heat of the flame, and its efficiency impaired. The temperature of the slide superheated by the interior and exterior flames is very high, and burns the oil on the slide faces, and the combination of these two defects causes frequent seizing. Bearing in mind what a deliberate operation must be the transporting of a flame in so confined a space, it is no matter of surprise that, however accurate the original adjustment may be, miss-fires are of very frequent occurrence, arising either from failure to ignite at the outside burner, or from premature extinction of the inside flame, or from absence of perfect balance at any moment; and these miss-fires must detract from the efficiency of the engine. When a rich gas, such as is used for domestic purposes, is employed, ignition, which depends, as has been shown, upon the equilibrium of pressures, is tolerably regular, because such gas is easy to light; but with a poor gas the problem becomes more difficult, and for this reason its employment has not made much progress. A

much stronger flame is required to ensure the ignition of a poor mixture with any degree of certainty. With a large engine, starting becomes an operation of great nicety when the flame has to be conveyed, because if the slide does not travel with sufficient rapidity the flame is burnt out before reaching the charge in the cylinder; and it is no easy matter to impart sufficient initial velocity to a fly-wheel of any considerable weight.

(To be continued.)

Experiments with Connellsville Coal in Foreign Coke Ovens.

Not long ago the *American Manufacturer* directed attention to the fact that some little attention had been given to the question of the by-products of Connellsville coal and their utilization in some one of the many kinds of ovens that are specially adapted to this purpose. The chief oven in use in England and Belgium for this purpose is the Carves, usually with M. Siemens' modifications. It is this oven that is in use so largely in the north of England. These ovens are built in blocks, each oven being in the form of a long, high, narrow chamber of brickwork, with partition wall between the ovens sufficiently thick to contain horizontal flues. Flues are also formed under the floors of each oven. The object aimed at in these ovens is to rapidly carbonize the coal by subjecting a comparatively thin layer to a high temperature in a closed and retort like vessel, and then, instead of burning the gases in the oven as is done in the bee-hive, the tar and ammoniacal liquors are first taken from them and they are then burned in the flues outside of the ovens, giving the heat by which the coal is coked. The tar and ammoniacal liquors are, especially in England, quite valuable, and it is claimed that not only is there with these ovens a greater yield of coke, but that the profit on the by-products is considerable.

We have had no late reports of the workings of this oven. The last statement made and published that we have at hand shows that at Bear-park each oven is charged with 4½ tons of coal; that, of the 50 ovens, 22 are drawn and recharged per day, except Sunday, when 15 only are drawn. From 76 to 77 per cent. of the coal charged is yielded in coke. The production of ammoniacal liquor is 29.08 gallons; of tar, 8 gallons; of ammonia, 5.09 gallons. At that time the value of these products per ton of coal was 1s. 3d.

The claims made for these ovens led some of our Connellsville coke makers to examine into the advisability of erecting them in the Connellsville region. The first thing to be learned was of course what was the amount and character of the residuals. To ascertain this a quantity of Connellsville coal was sent to England for the purpose of trial. The coal as assayed at St. Etienne, France, showed as follows:

Ammonia water, by distillation.....		4.76	
Ammonia water, by hygrometrical....		0.60	
			5.36
Tar			10.66
Coke.....	Carbon.....	63.55	
Coke.....	Ash.....	8.50	
			72.05
Gas, loss.	.....		11.93
Total.....			100.00

The coke was well agglomerated and without dust, some parts of the coke having a somewhat blistered appearance; the non-blistered parts of the coke, however, showed a good, hard grain. The ammonia water had a strength 34° Twaddle, at a temperature of 75° F., and reckoning the total ammonia contained in the coal which it was claimed was recoverable by the Simon-Carves process of distillation, as well as by washing the gas, and calculating the same as sulphate of ammonia, it was calculated that about 22 pounds of sulphate could be obtained per ton of coal. The tar appeared to be of dense quality and separated easily from the ammonia water. Of the 10.66 per cent. of tar, one-half, or say from 9 to 10 gallons per ton of coal, could be recovered, which is an excellent result.

Judging from the large proportion of ammonia water and tar recoverable from the coal, it was judged that Connellsville coal is eminently suitable for recovery of and very valuable for the by-products. This experiment was made in special apparatus, and was, after all, only experiment on a small scale. From experience with similar classes of coal, it was believed that when Connellsville was carbonized in the Simon-Carves ovens in charges of about 5 tons each, the coke obtained would be very good, and that it would be found that the proportion of blistered coke, as found by the assay, would be considerably diminished in practice.

By direct measurement, by means of a small gasometer, it was ascertained that the coal would make about 9,200 cubic feet of gas per ton. With regard to the yield of coal in coke, it was estimated that it would be about 72 per cent. fully; that is, the whole theoretical contents of carbon and ash.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

"BOSTON, MASS., July 13, 1889:—The JOURNAL usually can be depended upon to furnish accurate information in respect to the news matters reported in its columns; in fact it seldom errs. When it does make a slip, however, it makes a wide one, and this paragraph is prompted by a desire to correct a wrong impression that will undoubtedly be formed from reading the item in your issue for the 8th inst., which treats of the formation of a separate Gas Company for the town of Methuen, Mass. I make bold to say that the reader must come to the conclusion from what you printed that the Lawrence Gas Company had neglected to supply gas in a district that was virtually at its door. Such is not the case. The Lawrence Company has supplied gas in Methuen for years—true, the distribution system employed is not a very extensive one—and always stood ready to make pipe extensions; but the demand for the latter was not made. While I am not prepared to give the real reason for this sudden desire on the part of some Methuenites to organganize and operate a local Gas Company, the JOURNAL'S readers may rest assured that that reason is not to be found in any lukewarmness on the part of the proprietors of the old Lawrence Company, who are always quick to take advantage of a business opportunity. In conclusion, I might remark that it is possible that some electrical ruse is on foot at Methuen; and I might further remark that what you are pleased to term the Methuen 'separate company' may have much trouble in satisfying the Board of Gas and Electric Commissioners that it should be allowed to supply gas in the district.—OBSERVER."

THE Rockland (Me.) City Council has empowered the Commitiee on Street Lights to make a contract with the New York Eastern Electric Company for a certain number of 1,200-candle power arc lights. The rates are to be: 21 cents each per night for arcs burning from sunset to midnight, and 23 cents each for those not extinguished till sunrise. The contract is to last for 4 years—that is, if the resolution counts for anything; but we imagine this is one of the agreements that are made only to be repudiated.

THERE is every indication that the negotiations now under way looking to a consolidation of the New Bedford (Mass.) Gas and Electric Light Company and the local Edison Electric Light Company will terminate successfully. Should this come to pass, Mr. Taber will not have much trouble from competition in the New Bedford district.

THE Long Branch Electric Light Company will light the village streets by means of arc lights The Company pays $250 per annum to the village for "license to erect poles and place lights at will within the corporate limits."

ON the 3d inst. the Grand Rapids (Mich.) Gas Company was reorganized according to the provisions of the law passed at the last session of the Legislature. The Company has an authorized capital stock of $1,000,000, of which $400,000 is paid in. As permitted by that law, the old directors and officers continue in charge until January next. Under the reorganization the Company is authorized to supply gas and electricity.

IT is with regret that we chronicle the death (on the 9th inst., at her home in Philadelphia) of Sarah Evans Yocum, wife of Dr. Wm. H. McFadden, of the American Meter Company.

SOME time ago we announced the formation of a gas company for the town of San Leandro, Cal., the leading spirit in which was Mr. W. J. Landers. We now can say that the town is lighted by gas, and that the Landers enterprise gives promise of good profit. The authorities have contracted with the Company for the maintenance of 60 street lamps, to be paid for at the rate of $2 per month each, a moon-table system to be followed.

AT the annual meeting of the Long Branch (N. J.) Gas Light Company the following Directors were elected: H. E. Gawtry, G. N. Curtis, Geo. F. Baker, Samuel M. Janes and Jacob Steinbach.

THE Brush Electric Light Company has been endeavoring to prove to Mayor Waggener, of Atchison, Kas., that it would be to the city's benefit to install and operate an arc lighting plant. The Mayor appears to favor the project.

THE most important law of the past session of the New York Legislature which affected the gas interest was that introduced by Senator Linson in amendment of the gas meter inspection act of 1859. Briefly stated, the Linson measure provides that in case any gas company "shall neglect or refuse to pay into the State treasury the amount or portion of the salary of the inspector, which shall be at any time by the comptroller required of them respectively, for the space of 30 days after written or printed notice is given or sent by the comptroller to them, respectively, in the usual way by mail, to make such payment, then the comptroller is authorized and required to collect and recover the same from any such delinquent gas light company for its or either of their said portion or amount so determined to be due, with interest thereon at the rate of 10 per cent. per annum from the time when said notice to make such payment was given, together with the legal costs, fees and expenses of collection, in the name of the office of the comptroller," and so on.

WE are informed that Mr. C. A. Marden, formerly in charge of the plant of the Xenia (O.) Gas Company has leased the plant and franchises of the Coshocton Gas Company. We wish him good fortune.

AT the annual meeting of the Ashland (Wis.) Gas and Electric Light Company the following Directors were elected: Lewis A. Riley, John B. Price, Nicholas Graeber, Wm. A. Marr, Wm. H. Bright, Jacob Lessig, John X. Dencey, Geo. Morgan and Frank Rentz.

THE Thomson-Houston plant recently installed by the proprietors of the Washington Court House (O.) Gas Light Company was put in duty about a fortnight ago. The initial trial was in all respects successful.

MR. J.W. COWDERY, who for several years has acted as Superintendent of the Jackson (Miss.) Gas Light Company, has been appointed Superintendent of the gas supply of Atlanta, Ga., which is now virtually the property of the United Gas Improvement Company.

THE decision recently rendered by Judge Wallace, of the United States Circuit Court, in the case of the United Gas Improvement Company against the New Haven (Conn.) Gas Light Company, sustains completely the validity and scope of the Lowe patent. This suit was originally brought in August, 1886, for infringement of the Lowe patents, through the use by the New Haven Gas Light Company of the type of water gas apparatus known as the Hanlon-Leadley. Final argument in the case was heard by Judge Wallace last March. Messrs. Dickerson & Dickerson and Mr. Randall Morgan represented the plaintiff.

THE Trustees of the Hamilton (O.) Municipal gas works give notice that they will receive, up to noon of Aug. 7, proposals for 1,897 tons, more or less, of cast iron gas pipe of standard weight, quantities and sizes to be about as follows:

318	tons	12-inch pipe.
378	"	8-inch "
197	"	6-inch "
1,004	"	4-inch "

In addition to the above they require figures on about 30 tons of special castings. The Trustees reserve the right to increase or decrease the above quantities not more than 30 per cent. The bids to be for pipe and specials delivered on board the cars at Hamilton.

"SOME time ago I wrote you about the status of the proposed public lighting for Hamilton, Ont., and shortly after my letter was sent a complete revolution took place. I herewith send you an account of how the matter stood on the 5th inst. The new position assumed by the Gas Company required a pretty sudden shift, and it cannot be gainsaid that its proprietors, on the whole, have shown commendable enterprise in offering to supply electric light; for it is that the people demand. When the tenders were opened it was found that proposals had been made by the Hamilton Gas Company, the Hamilton Electric Company, the Edison Incandescent Company, and the Heisler Incandescent Light Company, of St. Louis. The Gas Company's propositions were: 1st, to furnish 700 to 750 gas lights or such increased number necessary to light the city entirely by gas, 5-foot burners, to burn all night, at $18 per annum each; 2d, to furnish 230 to 250 arc electric lights of the same character as those now in use—nominally 2,000-candle power, to burn every night in the year from dark to daylight—at 28 cents per night for each lamp; 3d, to furnish 100 to 150 arc lights and 400 to 500 gas lights, the electric lights to cost 30 cents each per night and the gas lights $18 each per annum; 4th, to furnish the same number of arc lights and gas lights on existing lines of mains, and in place of the present coal oil lamps in the outskirts, or any extension of lighting decided upon, to substitute incandescent lamps of 30 candle power, at the rate of $25 per annum each. The Hamilton Electric Light Company offered to supply 230 to 250 arc lights, same as now in use, at 30 cents each per night, or 100 to 150 arc lights at 40 cents each. The Edison Incandescent Lamp Company offered to supply 700 to 750 incandescent lights, of 30-candle power each, at $35 per year each, and 400 to 500 of the same type of lights at $36 each. If desired, the lamps on the business streets could be made of 40 or 50 candle power each. The Heisler Electric Light Company offered to furnish from 700 to 1,200 incandescent lights, of 30 candle power, or their equivalent in any other candle power up to 100, at the following rates per year for each light: 30-candle power, $20; 45-candle power, $28; 60, $35; 100, $55. In case a smaller number (400 or 500) was accepted a slightly higher rate would be demanded. These tenders were all discussed; but the one submitted by the Hamilton Gas Company met with the most favor. Finally, the Board agreed to recommend to the Council that the Hamilton Gas Company's tender, to supply 230 to 250 arc lights, at 28 cents each per night, and a limited number of incandescent lights be accepted. Should the Council ratify this recommendation the Gas Company will at once install a complete electric plant.—F."

THE differences between the authorities and the organizers of the gas plant for Dalton, Ga., have been settled, the city having agreed to adhere to its proposals to take a certain number of street lights. This means that construction work will be vigorously prosecuted.

THE Welsbach Light Company, of Findlay, Ohio, has been organized with a capital of $50,000.

MR. L. P. WILLIAMSON has been appointed by the Independence (Mo.) Gas Light and Coke Company to carry on the investigation to determine whether or not the coal process of gas making can be superseded by a cheaper method at that point.

MR. J. D. HERKIMER, of Mattoon, Ills., died on the 6th inst, He was one of Mattoon's most public-spirited men, and it is chiefly to his effort that Mattoon owes her gas supply.

ACCORDING to despatches, dated Pittsburgh, July 11th, it appears that the H. C. Frick Coke Company has absorbed all the interests of the Connellsville Coke and Iron Company, owned by the Leisenrings, of Philadelphia. This concern was one of the four members of the great coke syndicate which controlled the market for years, but which was disbanded in 1888. By the purchase of this plant and property the Frick Company beomes the largest coke producing concern in the world, owning as it does about 7,000 coke ovens and over 25,000 acres of coal land. The property purchased consists of 100 acres of coal land and 1,500 ovens.

ACCORDING to agreement, the Board of Gas and Electric Light Commissioners, continued their hearing—adjourned from the last week in May—on July 11th, on the petition of the South Boston, Roxbury, Brockton and other Massachusetts gas companies for the right to manufacture a gas containing more than 10 per cent. of carbonic oxide. In explanation of the long interval between the hearings it ought to be remembered that the Board asked from the Legislature last spring an explanation of the provision of the law which says that before a license is granted it [the Board] shall certify that the gas "can be used with safety." The Legislature failed to expound the text, hence the Commissioners must bear the burden of making the decision. W. E. L. Dillaway appeared as counsel for the companies, and Messrs. F. P. Addicks and Malcolm Peters were on hand to state reasons why the permission should be granted. The hearing assumed the form of a conference, and no one was present in opposition. In all probability the petition will be granted.

THE United Gas Improvement Company will erect a double superheater type of Lowe apparatus, with a capacity of 200,000 cubic feet per diem, at the works of the Lawrence (Mass.) Gas Company. The building is calculated to contain a second set of equal capacity.

THE same contractors will install, at the South End station of the Providence (R. I.) Gas Company, in a handsome new building (40 ft. by 80 ft. by 28 ft.), a double superheater setting of the improved Lowe type of apparatus, to have a per diem capacity of 800,000 cubic feet. The connections are to be 16-inch.

It is of course to be understood that the Lowe plants at Lawrence and Providence are in the nature of auxiliaries.

The Charlotte (N. C.) Electric Light Company has been awarded the contract for the public lighting of the city on the following basis: 50 or more 2,000-candle power arcs, to burn from dusk until mignight, at the rate of $5.25 per month. The contract is to last for 2 years. The Charlotte Gas Light Company (through Supt. S. E. Linton) submitted the following proposition: "We will furnish gas for lighting the city for from 1 to 3 years, with 116 lamps, for $1,950 per year, and will supply gas to the city buildings at the rate of $1.60 per 1,000 cu. ft." A moon schedule was to be followed by the gas company.

The Vandalia (Ills.) City Council has finally accepted the proposition of the Vandalia Light and Fuel Company to supply 100 incandescent street lights, of 25-candle power each, at the rate of $18 each per annum.

A special from Indianapolis is to the effect that within a fortnight the Consumers Gas Trust Company has filed a great many suits against delinquent subscribers to stock, and a legal fight is in progress that promises to test the law under which the Company is operating, and show that it is now practically insolvent. The Company was organized a year ago, and $500,000 stock was subscribed. A few months later another call for $250,000 in stock was made, and many of the original subscribers doubled their holdings. After a while it became apparent that the Trust would not lay its mains in all parts of the city, and the stock subscribers in such localities refused to pay for the second installment of stock. The Company then placed a mortgage of $700,000 upon its plant, and during the winter supplied gas for fuel in several parts of the city. It is claimed that the Trust is insolvent, and that, not having obtained gas as promised, the subscribers are not bound for the money. The shares are worth now perhaps 40 cents on the dollar.

Extensive improvements are being made on the plant of the old Rochester (N. Y.) Gas Light Company.

The Chicago Lighting and Supply Company has been chartered. The incorporators are Chas. E. Anthony, D. W. Manchester and Samuel Chandler. Capitalized in $25,000.

The Hearne Improved Gas Meter Company (Limited) has been incorporated. Its officers are: Chairman, Chas. Place; Chief Engineer, James Flannery; Gen'l Manager, John Hearne; Secretary and Treasurer, W. P. Elliott; Assist. Secretary, Frank H. Chenney. The offices are at 11 Pine street, New York, and 216 S. Third street, Phila., Pa.

A contract has been awarded to Mr. Adam Weber for furnishing the Citizens Gas Light Company, of Brooklyn, N. Y., with gas retort benches and generator work for the new plant, to have a per diem capacity of 2,000,000 cubic feet. These benches will be fired with the Weber modern recuperative furnace. The same gentleman has also been authorized by the New York Equitable Gas Light Company to furnish retorts, etc., for the improvements at the Stamford (Conn.) Gas Light Company's works.

At the annual meeting of the Bridgeton (N. J.) Gas Light Company the following officers were chosen: Directors, Jonathan Elmer, W. C Mulford, Chester J. Buck, Henry W. Elmer, M. D., and Daniel Elmer—the last named was elected to fill the vacancy caused by the death of his father. All the others are rechosen. President, Jonathan Elmer; Secretary, W. C. Mulford; Superintendent and Treasurer, Benjamin F. Harding.

Mr. Wm. H. Spaulding, the efficient Superintendent of the Clinton (Mass.) Gas Light Company, was united in marriage, on the 3d inst., to Miss Carrie Austin Pratt.

The Poughkeepsie (N. Y.) Gas Light Company, having made a thorough practical test of the material, write the Government Waterproof Paint Company, of Boston, Mass., as follows: "We find that your paint has given us better service than any other that we ever used. It is the paint for gas works."

The Committee on Gas (Chicago City Councils) have progressed Ald. Whelan's monstrous measure, which provides for the appointment of a board of gas inspectors—whose salaries and expenses are, of course, to be paid by the gas companies—who are to make a quarterly inspection of all gas meters that show a consumption of gas amounting in value to $15 per month.

The latest movement for a trust, which culminated in its virtual formation on the 1st inst., was amongst the manufacturers of gas fixtures. The headquarters of the trust are in Philadelphia.

Denver, Col., is still experiencing to the full the poverty of the street illumination furnished under the incandescent electric lighting contract now held by the local Consolidated Electric Light Company. During the month of June, according to the report of Lamp Inspector Jarechi to the authorities, that official tested 160 of the 16-candle power "nominal" lamps, the specimens being selected at random, and without the knowledge of the Company, and found that 76 were up to standard. Of the remaining 84 something like 50 per cent. were up to 12-candle power, running from that down to 8.14 c. p. The average of the whole, we believe, was 11.67 c. p. In addition to this the Inspector reports that many of the lamps exhibit a tendency towards "fitful illumination." Is it not time that Denver made up its mind that street lighting by means of incandescent electric lamps is a delusion and a snare?

In order to complete payment for the absorption of the local electric lighting plant, the Concord (N. H.) Gas Light Company has increased its capital stock to $150,000 from $100,000. We believe the ruling rate for the new shares is 160 on the par value of 100.

The Sioux City (Iowa) Gas and Electric Light Company has arranged for important plant betterments in both divisions of its service. A suitable plot of ground has been purchased, on which it is proposed to construct a brick building 50 by 150 feet, and 18 feet in height. This structure is intended to house the new electric apparatus which has been bargained for. The present electric plant will be operated until the opening of what is known as the "Corn Palace season," when the new dynamos will be put in duty. The authorities and the Company have about agreed on a new street lighting contract under the terms of which about 70 high-candle power arcs will be maintained in the business portion of the city, and the gas lamps thus displaced will be transferred to the residence sections, some of which are now but poorly illuminated. The gas works division is to be virtually rebuilt and remodelled, the plans contemplating an extension of 14 feet to the north side of the house, while 50 feet will be added to the eastern section. The height is also to be increased. The manufacturing plant is to be on a scale commensurate with the new housing, although it is not proposed to complete all the additions within the present season. In all probability a portion of the work will be reserved for next year. It is needless to add that these plans involve the expenditure of a large sum of money, but the proprietors thus show their confidence in the future of the artificial lighting business of what is without doubt one of the busiest cities in Iowa.

We understand that the London (O.) Gas Company was reorganized last week under the title of the London Gas and Electric Light and Strawboard Works Company. The electric light plant and the strawboard works are to be erected at once.

In all probability the Thomson-Houston and Brush electric plants at Macon, Ga., will before long be completely controlled by the Macon Gas and Water Company.

At the annual meeting of the Woburn (Mass.) Gas Company the following officers were elected: President, Benjamin Hinckley; Treasurer and Clerk, R. J. Monks; Directors, Benjamin Hinckley, R. J. Monks, G. R. Gage, Jno. Johnson and C. A. Jones. The annual reports were most reassuring.

A hint from Newton (Mass.) is to the effect that the Newton and Watertown Gas Light Company have this week broken ground for the foundations of a new brick and granite building (80 by 100 feet) in which to house its new electric light plant. The structure is to cost about $12,000, and is to be ready for occupancy on or about September 1st.

The final details in the consolidation of the gas and electric lighting supply of Nashua, N. H., have been completed. The factors in this agreement—the Nashua Gas Light Company and the Nashua Electric Light Company—are hereafter to be known as the Nashua Light and Power Company, to be managed by the following Directors: Messrs. Edward Spalding, Charles H. Nutt, J. W. White, J. H. Tolles and F. W. Estabrook. The Clerk is J. H. Tolles. Rumor had it during the last month or so that when the deal was finally completed the proprietors would advance the rates for both gas and electric light, but rumor seems to have been well out of the way, for it is quite likely that if any change is to occur in the selling schedule that change will be in the direction of lower rates.

THE new holder for the Brattleboro (Vt.) Company is well under way. Its dimensions are 50 by 20 ft., and it is to be inclosed in a brick house.

THE improvements at the Lee (Mass.) works are almost completed. The Company is now furnishing new burners ("pure oil gas" was the article formerly supplied) to all its consumers, without charge.

AT the meeting of the stockholders of the Laclede Gas Light Company, held on the 10th inst., no objection was offered to the stock and bond issues for providing funds for the acquirement of the plant and franchises of the old St. Louis Gas Light Company, etc. Briefly stated, the merged capital stock is to consist of $2,500,000 common and $7,500,000 preferred, and the complete property is to be covered by a heavy first mortgage, 20-year, 5 per cent. gold bond issue.

THE following are the bids submitted in response to the invitation of the Lansingburgh (N. Y.) authorities for the lighting of the streets by electricity: Troy Citizens Gas Light Company, 100 arcs (2,000-candle power), to burn all night and every night, $120 each; or 100 (1,200-candle power) arcs at $90 each; Mutual Electric Manufacturing Company (Brooklyn), 100 arcs (2,000-candle power) for $7,999 per annum, and $79.99 for each additional light, the Company reserving the privilege of furnishing incandescent lights for commercial purposes; the Union Electric Light and Power Company, 100 arcs (2,000-candle power), for $8,900, the Company agreeing to place one arc light in front of Fireman's Hall, and one additional light for each 30 commercial arcs secured by the Company; or would supply any required number of 25-candle power incandescent lights at $18 each per year—the last bidder estimated that 320 lights of the 25-candle power variety would be ample. The bids having been read, Trustee Demers moved that a special election of taxpayers be called at Fireman's Hall, on Tuesday, Aug. 6, to vote upon the question of appropriating $7,999 for 100 2,000-candle power lights, or $5,760 for 320 25-candle power incandescents, the form of ballots to be decided and determined by the Village Attorneys. Trustee Draper said that as the Union Company's bid was by inference for 2,000 actual candle power, and that of the Mutual Company for 2,000 nominal candle power, the former Company's bid should be given the preference—quite an idea. Trustee Dennin suggested that the taxpayers should be given a chance to vote upon any of the bids offered, which suggestion was accepted by Trustee Demers, who moved its adoption, the form of ballots and the legality of the election to be decided by the Attorneys. An amendment by Trustee Draper that the appropriation for arc lights be set at $8,900 was lost by a vote of 3 to 5, and the Demers motion was unanimously carried.

AN act to incorporate the Farmington (N. H.) Gas, Electric Light and Power Company has been referred to the State legislative committee on incorporations.

THE proprietors of the North Attleboro (Mass.) Gas Company have made a proposition to the town authorities to light the streets by electricity, for a period of 5 years, in consideration of the payment of $50 per arc per annum. The lights, we believe; are to be extinguished at midnight.

THE Boston syndicate are said to be anxious to purchase the plant and franchises of the Taunton (Mass.) Gas Company. Of course it is easy to understand why such anxiety should exist; for the Taunton Company is a very valuable property. We believe, however, that its present proprietors are perfectly cognizant of its value and stability.

MR. ASHDOWN, who for years has been the efficient and trustworthy Superintendent of the Santa Fe (New Mexico) Gas Company, has resigned that berth in order to take charge of a gold mining enterprise in the Dolores region. Mr. Ashdown is to be succeeded at Santa Fe by Mr. Thomas Littlehales, a nephew of Mr. Littlehales of Hamilton, Ont.

INVESTORS might do well to bear in mind the following resolution passed by the Board of Directors of the Consolidated Gas Company of Baltimore, on the 16th inst.: "In pursuance of a resolution of the Board of Directors, notice is hereby given to all holders thereof that all the outstanding certificates of indebtedness of the late Chesapeake Gas Company, of Baltimore city, the payment of which has been assumed by this Company, will be reclaimed by the payment of the amount thereof, with interest, at the office of this Company, in the city of Baltimore, on the 16th day of August next, and that the interest thereon will from and after that date cease."

THE Rochester (Minn.) authorities have agreed to contract with the local Gas Company for the public lighting.

ROCK HILL, S. C., wants an electric light plant and a water works. The Mayor of the city has the matter in hand.

THE Paterson (N. J.) Electric Illuminating Company wants to light the local Police Station building, and wants the task so badly that it has offered to wire the building without charge, and carry on the lighting at a cost 20 per cent. below that now paid the Gas Company.

AT the annual meeting of the Consolidated Gas Company, of Baltimore, the following result was reached: 61,833 votes were cast, and the Directors re-elected were Messrs. E. C. Benedict, W. B. Brooks, Wm. F. Burns, Bernard Cahn, W. S. Carroll, H. J. Davison, W. F. Frick, James A. Gary, John W. Hall, Henry James, D D. Mallory, Wm. W. Spence. The report of the Treasurer was referred to a committee of stockholders, to be reported at a future meeting. The Board re-elected the following officers: John W. Hall, President; Wm. S. Carroll, Vice-President; L. R. Smoot, Secretary; Joseph W. Clarke, Treasurer. A blanket mortgage for $7,000,000 was recorded from the Consolidated Gas Company of Baltimore to the Mercantile Trust and Deposit Company of Baltimore. The mortgage is to provide for the payment of the mortgage and other indebtedness of the three gas companies composing the present Consolidated, which that Company assumed under its organization on May 5, 1888, and also the outstanding certificates of indebtedness of the defunct Chesapeake Gas Company. The indebtedness of the companies is as follows: Old Consolidated Company, $3,600,000; Chesapeake Gas Company, $1,000,000; Equitable Gas Light Company, $1,000,000, and outstanding certificates of the Chesapeake, $781,000, making a total of $6,381,000. The balance of the sum will be used in making improvements of its property and for other purposes. The Consolidated Company will issue its first consolidated mortgage bonds, payable to the Mercantile Trust and Deposit Company, or bearer, for the aggregate sum of $7,000,000. The bonds will be for $1,000 each, and numbered from 1 to 7,000. They are payable in gold coin, at the end of 50 years, and will bear 5 per cent. interest, payable semi-annually, on January 1 and July 1 in each year, commencing on January 1, 1890. The bonds will contain a provision that in no event shall the several stockholders of the Company be held liable for the payment of the principal or interest of the bonds. The mortgage is secured by all the real and personal property of the Consolidated Company, and all its corporate rights and franchises.

Recent Patent Issues.

The following list of recent patents relating to the gas interests is specially reported by Franklin H. Hough, solicitor of American and foreign patents, 925 F street, N. W., Washington, D. C.

ISSUE OF JULY 2, 1889.

406,124. Apparatus for Scrubbing and Washing Gas. S. Chandler, Sr., S. Chandler, Jr., and J. Chandler, London, England.
406,229. Gas Burner Stoves T. McSweeney, Allegheny, Pa.
406,263. Gas Engine. L. T. Cornell, Chicago, Ills.
406,241. Gas Leak Detector. J. F. Stark, New Haven, Pa.
406,192. Gas Lime. J. Bell, Brooklyn, N. Y.
406,160. Gas Motor. E. Captain, Berlin, Germany.

ISSUE OF JULY 9, 1889.

406,819. Apparatus for Manufacturing Gas. J. M. Critchlow, Beaver Falls, Pa.
406,637. Gas Apparatus for the Manufacture of Fuel. G. S. Dwight Montclair, N. J.
406,584. Gas Burner. A. P. Jacobs, Philadelphia, Pa.
406,860. Gas Burner for Stoves and Fireplaces. J. Smithley, Pittsburgh, Pa.
406,807. Gas Engine. C. White and A. R. Middleton, Baltimore, Md.
406,706. Gas or Oil Motor Engine, Compound. W. J. Crossley, Openshaw, England.
406,718. Gas Through Mains, Apparatus for Forcing. J. S. Fish, Choestoe, Ga.

ISSUE OF JULY 16, 1889.

407,025. Apparatus for Scrubbing and Washing Gas. K. M. Mitchell, St. Joseph, Mo.
407,291. Gas Burner. C. J. Hamilton, Philadelphia, Pa.
407,134. Gas Burner, Heating. S. Stewart, Newark, N. J.
407,267. Gas from Petroleum Oil, Apparatus for Generating. A. Weyer, Tallapoosa, Ga.
407,289. Gas Furnace. R. S. Franz, Glenshaw, Pa.
407,237. Gas Mixer. W. S. Payne, Elmira, N. Y.
406,894. Gas Pressure Gauge and Regulator. G. B. Fearnley, Brixton, England.
406,979. Gas Trap and Sink. W. Wallace, San Francisco, Cal.

The Market for Gas Securities.

There was no great change in the situation on the Stock Exchange during the week respecting the local gas share market, unless it be that some weakness was developed in Equitable, which is now offered at 123 as against the 125 bid of last Friday. Brooklyn shares show no change. All the opposition talk of months back in reference to the annual election of the Baltimore Consolidated was meaningless, the old Board and executive management being re-elected. The stock is stronger, and looks to us to be a purchase. Chicago Trusts are down to 57.

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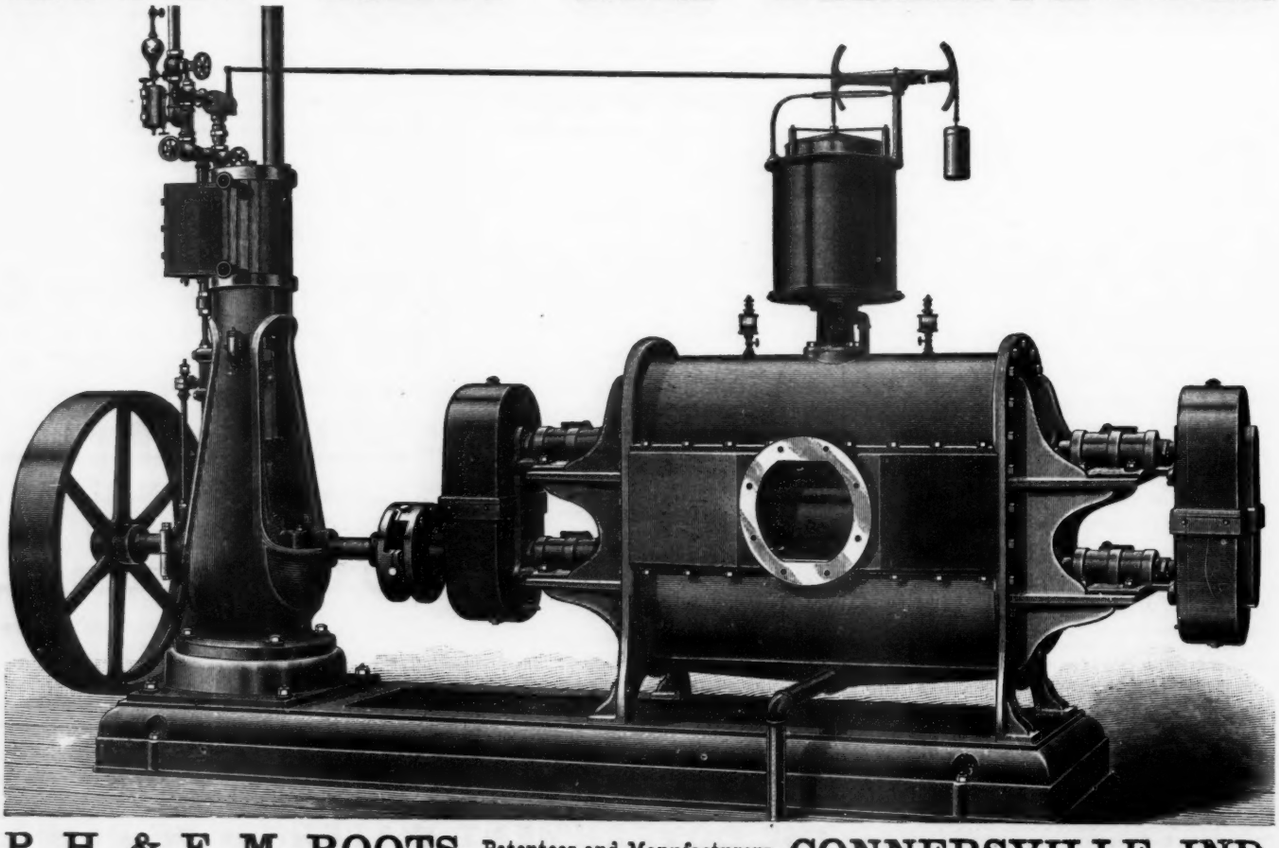

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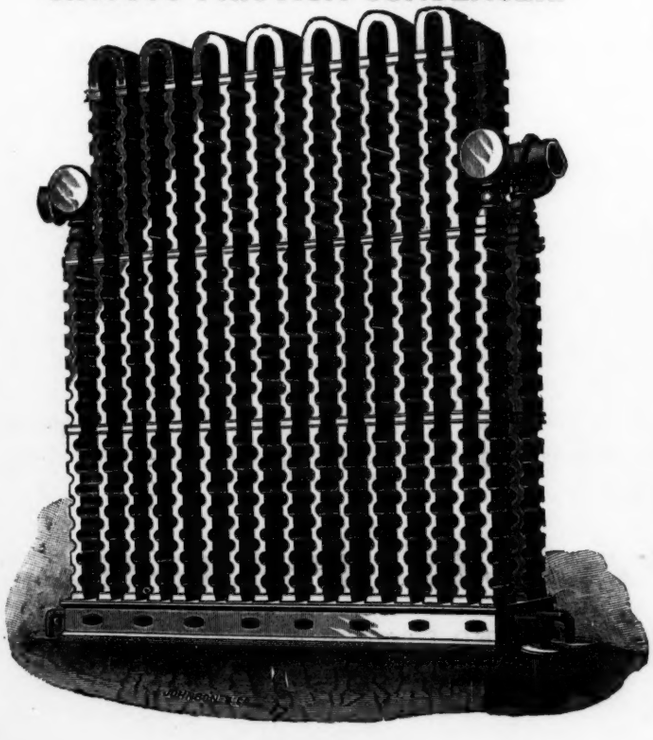

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The following Engineers have personally given permission to refer to them:

G. C. Trewby, Esq., Engineer-in-Chief of the Gas Light and Coke Co., London. The manufacturing plant at Beckton is built in complete sections of 3,000,000 cubic feet capacity each. A Walker Tar Extractor has been fitted to each one of these sections. This was done after a long and thorough trial on one of its sections. The Tar Extractor has been supplied to other works of the Gas Light and Coke Co., including those of which John Methven, Engineer of the Gas Light and Coke Co. at the Nine Elms Station, is in charge. Also to G. E. Stevenson, Peterborough Gas Works; B. Green, Mitcham and Wimbledon Gas Works; W. H. Smith, Bedford Gas Works; F. Linging, Norwich Gas Works; J. T. Browning, Colchester Gas Works; S. B. Darwin, Portsmouth Gas Works; J. McCrae, Dundee Gas Works; W. J. Wells, Stamford Gas Works; J. M. Darwin, Longton Gas Works; J. Paterson, Warrington Gas Works; and J. Coulter, of the Dundalk Gas Works. All of the foregoing gas works are located in Great Britain.

Mr. Charles A. Gerdenier, Superintendent of the Bridgeport (Conn.) Gas Light Company, writes as follows, under date of Dec. 3, 1887:

"The C. & W. Walker Tar and Carbonic Acid Extractor has been in operation at these works for the past six weeks, and is an unqualified success. It removes every particle of Tar from the gas in once passing through the apparatus, and a large percentage of the Carbonic Acid. I also feel quite sure that it prevents the formation and deposit of Naphthaline, because since I started the Washer I have had no stoppages from this cause. These works have been seriously troubled with Tar for many years, and I have used several kinds of apparatus and every expedient which has come to my attention for dealing with the difficulty, but without success. The Walker apparatus occupies comparatively small space, is less expensive than other systems, and requires but little attention. I carry 2½-inch seal, and have an automatic tar delivery valve. This Tar Extractor is indispensable to gas makers."

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No. 1,	50,000	to	100,000	cu.	ft.	per	24	hrs.,	3	ft.	square, 5 ft. deep.
No. 2,	"	"	125,000	"	"	"	4	"	"	"	"
No. 3,	"	"	250,000	"	"	"	5	"	"	"	"
No. 4,	"	"	500,000	"	"	"	6	"	"	"	"
No. 5,	"	"	750,000	"	"	"	7	"	"	"	"
No. 6,	"	"	1,000,000	"	"	"	8	"	"	"	"
No. 7,	"	"	1,250,000	"	"	"	9	"	"	"	"
No. 8,	"	"	1,500,000	"	"	"	10	"	"	"	"
No. 9,	"	"	2,000,000	"	"	"	12	"	"	"	"
No. 10,	"	"	3,000,000	"	"	"	15	"	"	"	"

This Tar Extractor will perform its work with about one-fourth the usual back-pressure heretofore required. It is simple in construction, and can be supplied at a very reasonable price—less than any other ever before introduced. Satisfactory results will be guaranteed in every instance.

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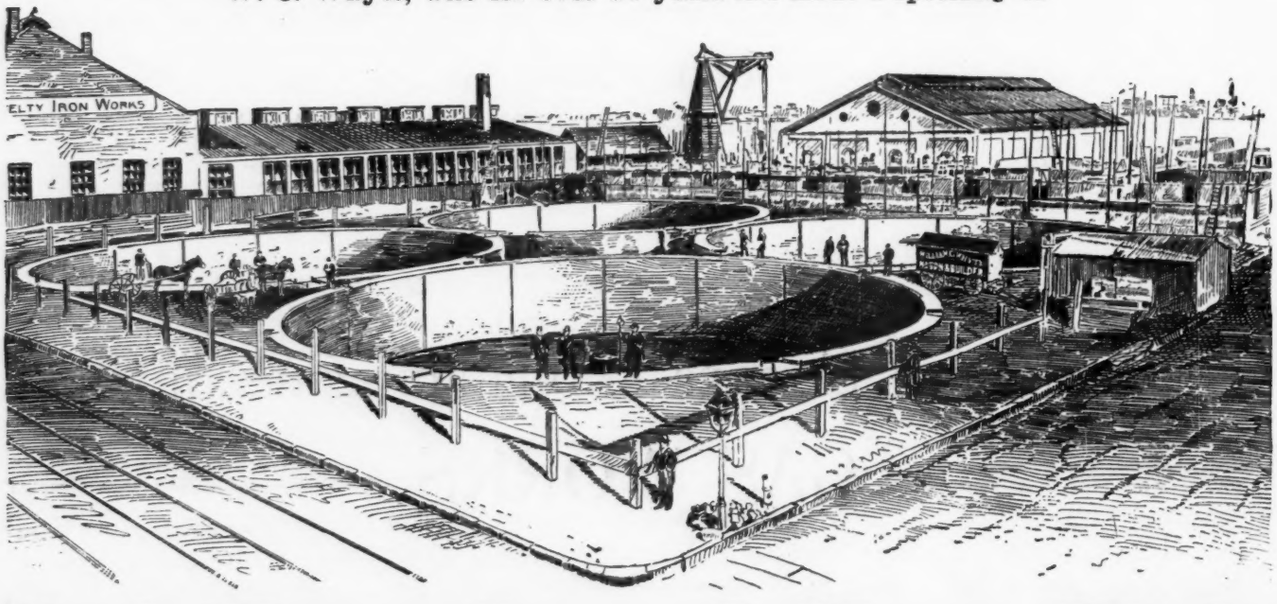

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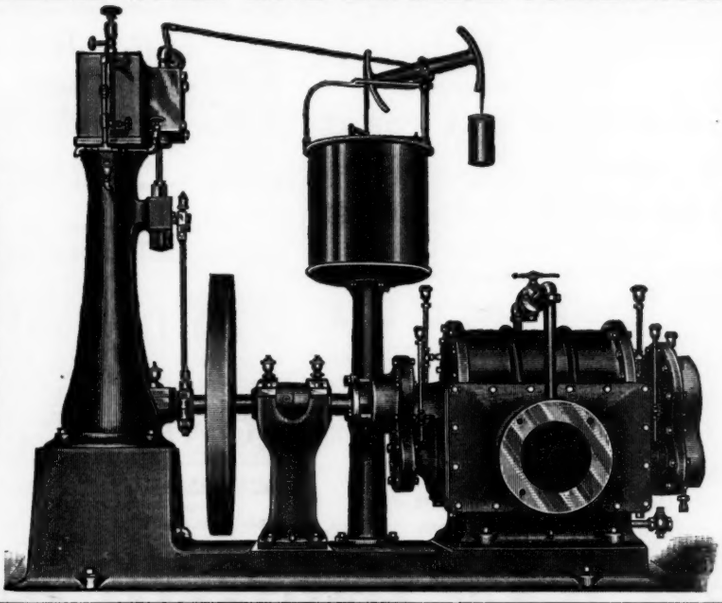

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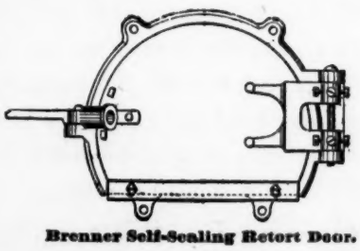

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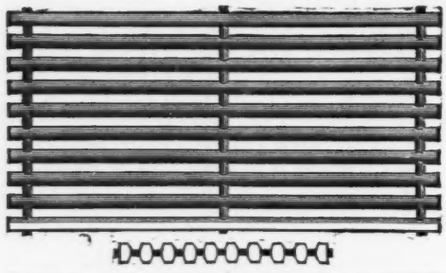

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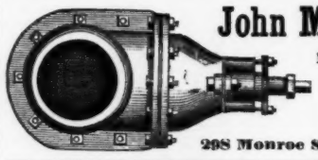

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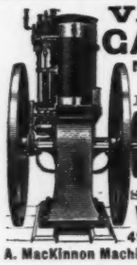

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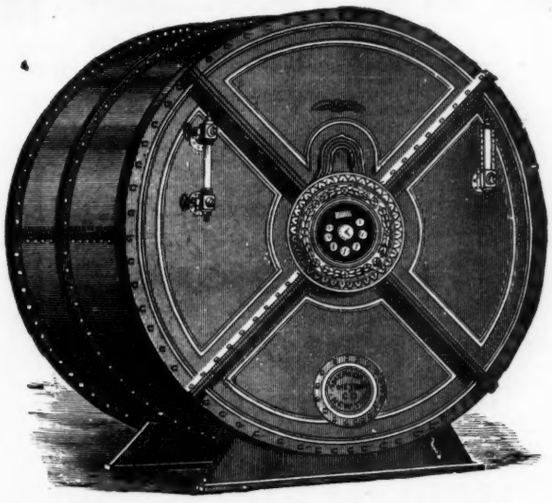

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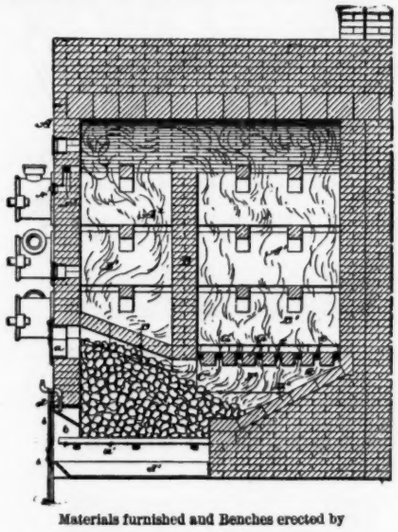

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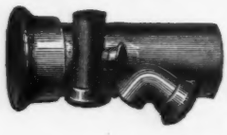

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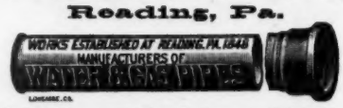

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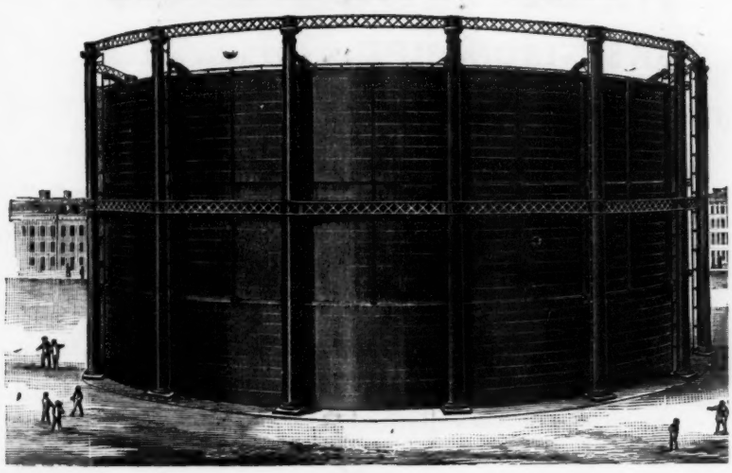

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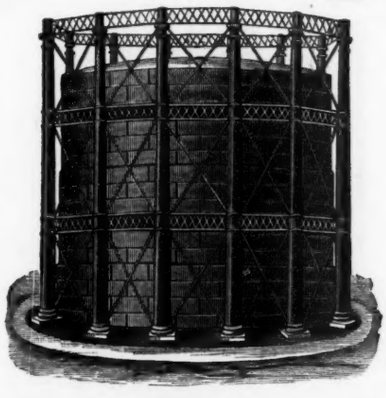

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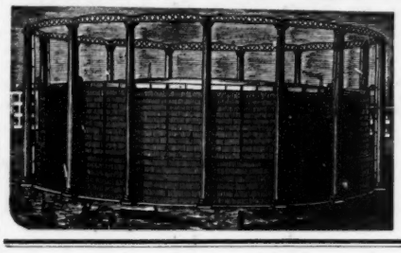

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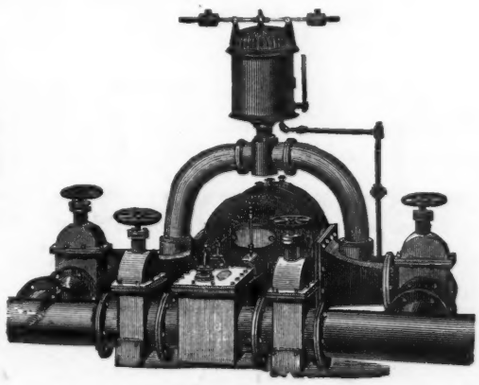

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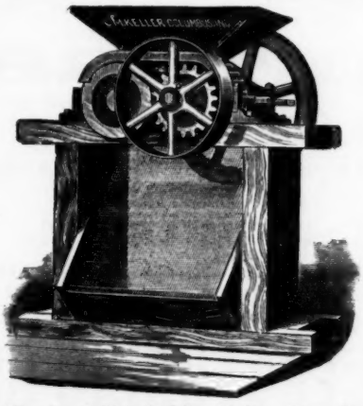

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SIZE.

Stove.	Oven.	Roaster.	Top.	Length over Extension Shelves,
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20 in. wide.	17½ in. wide.	18 in. wide.	21 in. wide.	
	12 in. deep.	13 in. deep.		

This Stove has four burners on top, and double oven burner.

Consumption of gas with all burners in use, 42 feet per hour, at 1 inch pressure.

The top is made in sections, so that a greater variety of cooking utensils may be used. By lifting out the covers and crosspieces and putting in a suitable forked ring, which is sent with each stove, a wash boiler or other large utensil may be set over two burners. Our **No. 87 GRIDDLE** also fits in the same position. The roasting oven is provided with a cast-iron door.

All Fittings are Nickel-Plated.

GAS COOKING STOVE, No. 7 B.

SIZE.

Stove.	Oven.	Roaster.	Top.	Length over Extension Shelves,
31 in. high.	9½ in. high.	10 in. high.	21 in. long.	32 in.
17 in. wide.	14½ in. wide.	15 in. wide.	16 in. wide.	
	12 in. deep.	13 in. deep.		

This Stove has three boiling burners in the Top or Hot Plate, and one single oven burner.

This cut represents our New Style Cooking Stove. As will be seen, it has an ornamented cast-iron Base and Front, and extension shelves. The Oven Burner, which is atmospheric (unless otherwise ordered), is of an entirely new and improved pattern (patent). The ovens are of greater capacity than those of the old style. The Top, in conjunction with the Outlet Pipe, is designed to carry off all the products of combustion, if desired, but they are also supplied with a loose ring which converts it into an ordinary open top stove.

The consumption of this Stove is 35 cubic feet per hour at 1 inch pressure, with all Burners in use.

All Fittings are Nickel-Plated.

"RADIANT" BOILING STOVE, WITH REGENERATIVE BURNER.

Size, 6¾ inches diameter, 8 inches high. Consumption, 6 feet per hour at 1 in. pressure.

HOT PLATE, No. 111.

Size, 36 in. long, 12 in. wide, with three double burners, 6 taps.

Consumption, with all burners in use, 36 cubic feet per hour, with 1 in. pressure.

¾ in. supply pipe should be used where the pressure is 1 in. or over.